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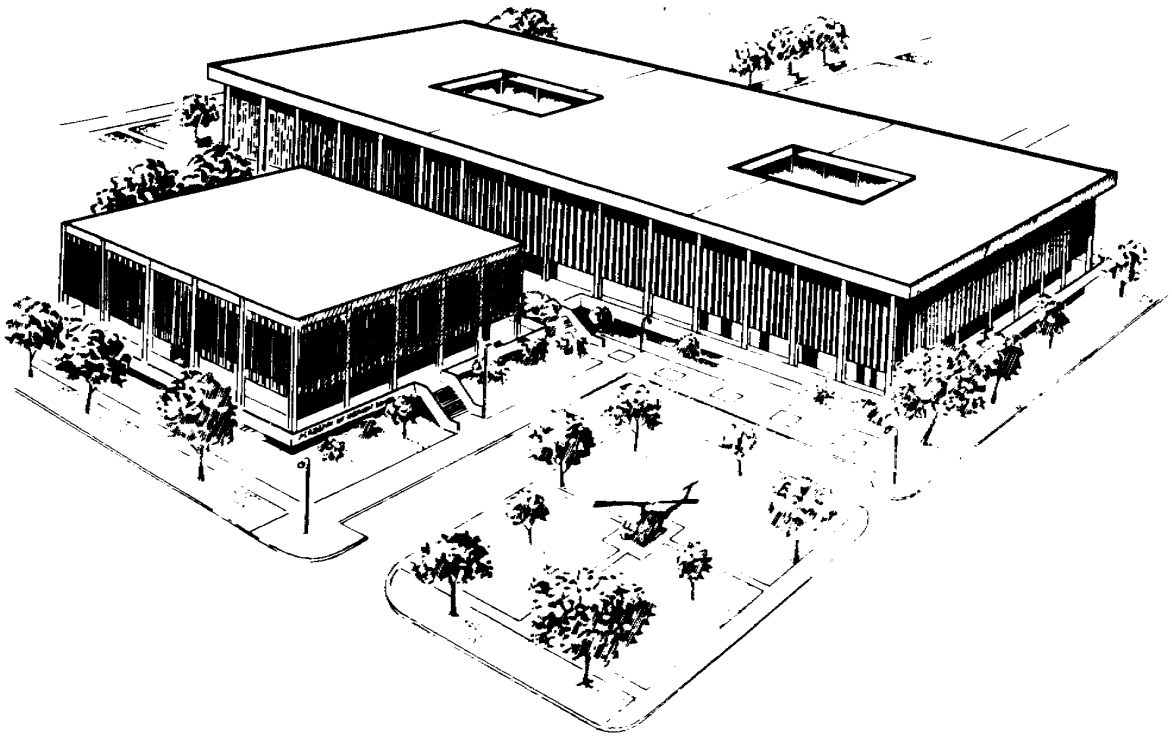
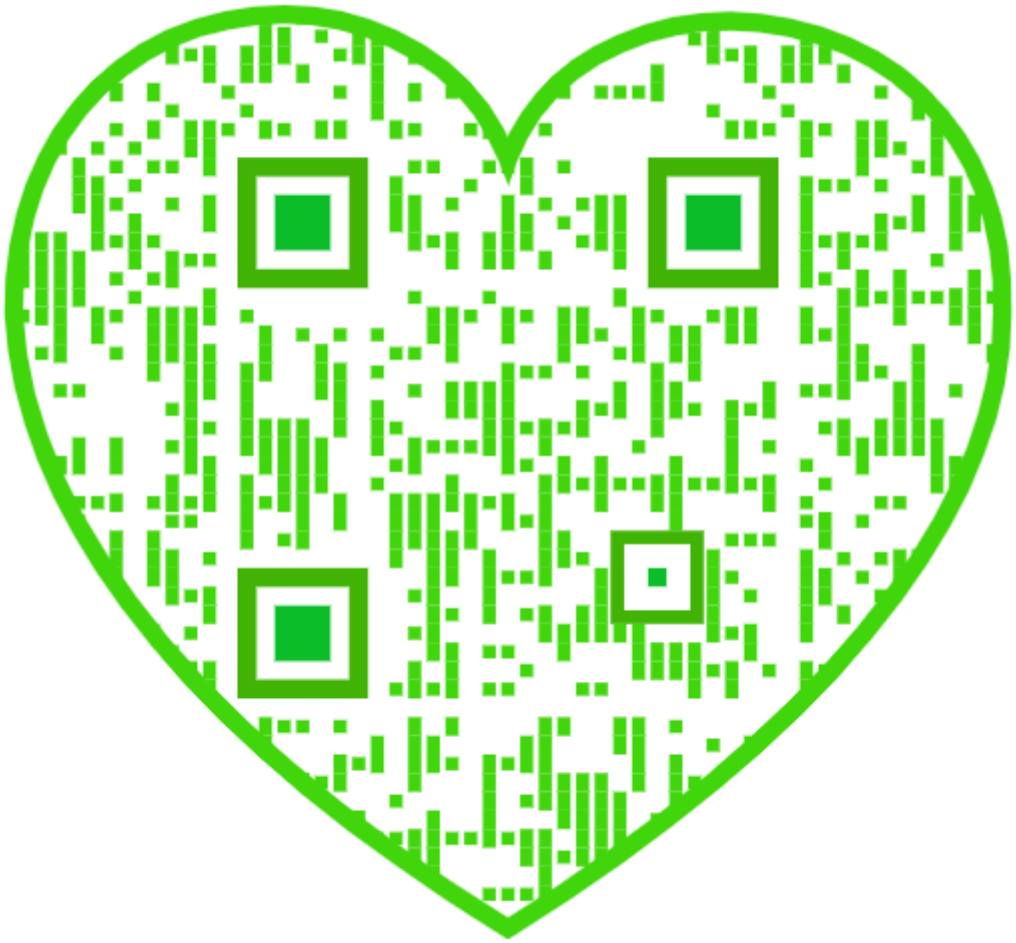


ENVIRONMENTAL INJURIES/DISEASES II

SUBCOURSE MD0589 EDITION 100



DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

Students who desire credit hours for this correspondence subcourse must meet eligibility requirements and must enroll in the subcourse. Application for enrollment should be made at the Internet website: http://www.atrrs.army.mil. You can access the course catalog in the upper right corner. Enter School Code 555 for medical correspondence courses. Copy down the course number and title. To apply for enrollment, return to the main ATRRS screen and scroll down the right side for ATRRS Channels. Click on SELF DEVELOPMENT to open the application and then follow the on screen instructions.

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CLARIFICATION OF TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0589

ENVIRONMENTAL INJURIES/DISEASES II

INTRODUCTION

Throughout history, infectious organisms have plagued society. Biblical accounts of plagues attest to this fact. In London in the 1600s, the Black Plague killed thousands of people. In a combat situation, the impact of disease on the combat soldier cannot be overstated. In every war in which the American soldier has fought, there have been more casualties caused by disease than by combat wounds. An outbreak of a simple intestinal disease in a combat zone can greatly affect the morale and fighting strength of the Army. Information concerning the identification, treatment, and preventive measures for arthropod-borne, animal-borne, and helminthic diseases will be discussed in this subcourse. As a Medical NCO, it is extremely important that you are aware of the prevention and treatments for the numerous diseases which you will encounter. With the awareness of those diseases, their general characteristics, modes of transmission, and clinical findings, you may be alert for either treatment or prevention.

Subcourse Components:

The subcourse instructional material consists of four lessons as follows:

Lesson 1, Arthropod-Borne Diseases.
Lesson 2, Animal-Borne Diseases.
Lesson 3, Helminthic Diseases.
Lesson 4, Malaria.

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded 7 credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Arthropod-Borne Diseases.
LESSON ASSIGNMENT	Paragraphs 1-1 through 1-11.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

1-1. Identify terms and definitions associated with arthropod-borne diseases.

1-2. Identify the fly-borne diseases, their characteristics, signs/symptoms, and treatment.

1-3. Identify tick-borne diseases, their characteristics, signs/symptoms, and treatment.

1-4. Identify louse-borne disease, their characteristics, signs/symptoms, and treatment.

1-5. Identify flea-borne diseases, their characteristics, signs/symptoms, and treatment.

1-6. Identify mosquito-borne diseases, their characteristics, signs/symptoms, and treatment.

1-7. Identify plague disease, its characteristics, signs/symptoms, and treatment.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

ARTHROPOD-BORNE DISEASES

Section I. FLY-BORNE DISEASES

1-1. INTRODUCTION

Arthropods are any of the insects, arachnids, or crustaceans consisting of a jointed body and limbs with the brain dorsal to the alimentary canal and connected with a ventral chain of ganglia. The source of the arthropod-borne disease is known as the reservoir. The vector, usually an arthropod, transmits the causative organisms of disease to a susceptible person. The organism on which the parasite lives and from which the parasite obtains its nourishment is called the host. Autoinfection describes an infection by bacteria that is present within one's own body.

1-2. GENERAL

a. **Transmission.** Diseases are transmitted by houseflies on their hairs and in their feces and vomitus. Flies breed in manure, human waste, and decaying organic matter. This decaying organic matter is defined as the fly's host since it provides the fly with nourishment. Flies ingest the solid food by vomiting the contents of their stomach onto the food and then sponging it up.

b. **Diseases.** Dysentery, cholera, and typhoid fever are the most important diseases transmitted by flies.

1-3. DISEASE TRANSMITTED BY FLIES

a. **Dysentery.**

(1) General. Dysentery is the term applied to a number of intestinal disorders (especially of the colon) that are characterized by inflammation of the mucous membranes. It is a common disease that is often self-limiting and mild but can be serious for babies up to 3 years old. A rise in strains of dysentery which are resistant to multiple antibiotics has been noted recently.

(2) Signs and symptoms. Dysentery usually begins abruptly and the patient has diarrhea, and suffers lower abdominal cramps and tenesmus. Blood and mucus are often found in the diarrheal stool. Other symptoms include fever (up to 104ºF in young children), chills, headache, and lethargy. Meningismus, coma, and convulsions occur in the most severe cases. Dehydration, weakness, and a tender abdomen follow as the illness progresses. In infants, dehydration, acidosis, and electrolyte imbalance occur.

(3) Treatment. The antibiotic of choice is ampicillin (100 mg/kg/d) which can be given for 5 to 7 days orally in 4 divided doses. If there is improvement, do not continue with the medication any longer even if the stool cultures are still positive. Other medication effectively used in treating dysentery are tetracycline, chloramphenicol, or co-trimoxazole. Actually the use of even mildly toxic antibiotics is usually not justified because the majority of cases are mild and self-limited. For all moderately or severely ill patients, parenteral hydration and correction of acidosis and electrolyte disturbances are a necessity. Give clear fluids for 2 or 3 days after the bowel has been at rest for a short time and offer the patient small frequent feedings with a diet that is soft and easily digestible. Whole milk, high residue, and fatty foods should be avoided. If cramps are severe, anti-spasmodics (i.e., tincture of belladonna) may be helpful. Place the patient on effective stool isolation precautions to limit the spread of infection.

b. **Cholera.**

(1) General. Cholera is an acute bacterial diarrheal disease of the small intestine. Cholera is caused by Vibrio cholerae which are transmitted by food or drink that is contaminated by feces containing a large number of vibrios. These vibrios produce a powerful exotoxin in the small intestine (in particular, the ileum) where they grow. The reduction of the sodium reabsorption causes massive diarrhea that is fatal in 50 percent of cases if untreated. This exotoxin induces hypersecretion of water and chloride in the small bowel.

(2) Signs and symptoms. Cholera victims experience a sudden onset of painless, watery diarrhea of up to 15 liters per 24 hours. The liquid stool is grayish containing mucus and food particles. There is no fecal odor, blood, or pus, but rapid dehydration takes place. The patient may have occurrences of vomiting and becomes markedly dehydrated and acidotic. His eyes are sunken and he experiences intense thirst, hypotension, a subnormal temperature, oliguria, shock, muscle cramps, and coma.

(3) Treatment. The loss of water and electrolyte must be restored immediately and continuously, and acidosis must be corrected. Replacement of oral fluids (same volume as that lost) may be possible in the moderately ill patients. If the patient is unable to take fluids by mouth, an I.V. infusion of Ringer's lactate must be used to replace the fluids until the blood pressure and circulating blood volume are restored. The medication used to suppress vibrio growth and shorten the time of vibrio excretion is tetracycline, 0.5g given orally every 6 hours for 3-5 days. If untreated, cholera lasts 3-5 days and has a mortality rate of up to 80 percent. If the victim receives prompt and competent treatment, however, the mortality rate can be reduced to 1 percent. The health department must be notified if it is suspected that a victim has cholera.

(4) Prevention. The cholera vaccine consists of 2 injections of 0.5 and 1 ml. intramuscularly or subcutaneously 1-4 weeks apart, then a booster dose of 0.5 ml is administered every 6 months when cholera is a hazard. Even so, the vaccine offers only limited protection and has no value in controlling outbreaks. All water, other drinks, food, and utensils must be boiled or avoided in endemic areas. When high standards of sanitation and public health exist, there is rarely an outbreak of cholera of any significant size.

c. **Typhoid Fever.**

(1) General. The gram-negative rod Salmonella typhi causes typhoid fever when it enters the victim's gastrointestinal tract, penetrates the intestinal wall, and produces lesions and inflammation of the mesenteric lymph nodes, spleen, and small intestines. The organisms can localize in the kidneys, central nervous system, the gall-bladder, or the lungs with inflammation. The Salmonella typhi is transmitted by consumption of food or drink contaminated by food handlers who are healthy carriers. The chronic carriers with persistent gall-bladder or urinary tract infections are the main source of most infections.

(2) Signs and symptoms. The onset of typhoid fever is insidious but can be very abrupt (especially in children) with a sharp rise in temperature with chills. If untreated, typhoid fever can be divided into three stages: the prodromal stage, fastigium, and the stage of defervescence.

(a) Prodromal stage. The victim experiences increasing malaise, headache, sore throat, diarrhea or constipation, abdominal pain, vomiting, and the fever ascends in stepladder fashion with each day's maximum higher than the preceding day.

(b) Fastigium. The fever stabilizes after 7-10 days, and the victim becomes quite sick. He is motionless and unresponsive, has half-shut eyes, and appears wasted and exhausted. He has marked abdominal distention along with "pea soup" diarrhea or severe constipation.

(c) Stage of defervescence. The victim surviving the fastigium stage (with its severe toxemia) without complications may show improvements gradually. His feverish temperature descends to normal in 7-10 days, and he becomes alert. Relapse may occur as much as 1-2 weeks after the temperature returns to normal, but the relapse is usually milder than the original illness. There is a possibility of having a cardiac arrhythmia. In about 10 percent of the patients, rose spots (rounded, rose-colored spots that blanch on pressure) appear between the 7th and 10th day of illness. These spots last from 2 to 5 days and then disappear.

(3) Complications. There are complications in approximately 30 percent of the untreated cases, and these account for 75 percent of the deaths from typhoid fever. During the third week, intestinal hemorrhage can occur with a resulting sudden drop in temperature, sometimes a sudden rise in pulse rate, pallor, sweating, hypotension, and abdominal pain. Other symptoms of less frequency include urinary retention, myocarditis, pneumonia, nephritis, thrombophlebitis, psychosis, cholecystitis, spondylitis (typhoid spine), and meningitis. Intestinal perforation, the most frequently fatal complication, is most common during the third week in adult males. Sharp abdominal pain occurs suddenly (usually in the right lower quadrant) with nausea, vomiting, fall in temperature, rapid pulse, and muscle spasm.

(4) Prevention. Typhoid immunization should be provided for household contacts of a typhoid carrier, for individuals traveling to endemic area, and during epidemic outbreaks. The vaccine consists of 2 injections of 0.5 ml each, subcutaneously, 4 weeks apart. Carriers of typhoid are not permitted to handle food.

(5) Treatment. Administer ampicillin in 4 equal doses per day, 1 dose every 6 hours for 14 days. Each dose is 25mg/kg. Another medication for typhoid fever is chloramphenicol, 1 g, which is given every 6 hours orally or it may be given intravenously until the fever disappears. After this, give chloramphenicol for 2 weeks at 0.5 g every 6 hours (for children, 50 mg/kg daily). If the infection is resistant to ampicillin and chloramphenicol, the victim may respond to trimethoprim-sulfonamide mixtures. The patient should have a high-calorie, low-residue diet, and his skin must have care. It may be necessary to administer parenteral fluids in order to supplement oral intake and maintain urine output. If the patient is severely toxic, administer hydrocortisone, 100 mg intravenously every 8 hours.

Section II. TICK-BORNE DISEASES

1-4. GENERAL

Ticks are common in woods and fields through the United States. They are divided into two groups: the hard ticks and the soft ticks. The hard tick has a hard shield on its back, and its mouth parts can be seen from above (figure 1-1). The soft tick does not have a hard shield on its back, and its mouth parts cannot be seen from above (figure 1-2). Ticks often have a leather-like appearance and are persistent blood suckers. They cannot be dislodged easily while they are feeding and transmitting harmful bacteria, viruses, and so forth. Ticks can remain submerged in water for long periods, and they are relatively free from natural enemies but have wide range of hosts to feed upon. They have been known to live fourteen years or more and are able to pass infection from one generation to another. The female can lay as many as 18,000 eggs. The four stages which a tick passes through are the egg, larva, nymph, and adult. Unfortunately, the bite is not always felt, and the victim is subject to an encephalitis virus, hemorrhagic fever virus, Colorado tick fever virus, or Rocky Mountain spotted fever virus, which the tick can transmit through the bite.

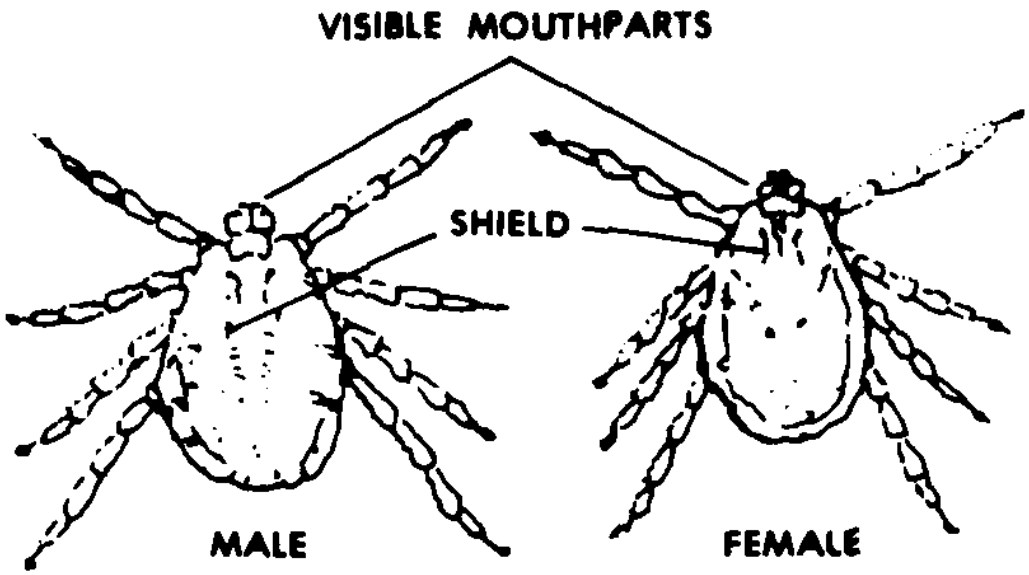

Figure 1-1. Adult hard ticks.

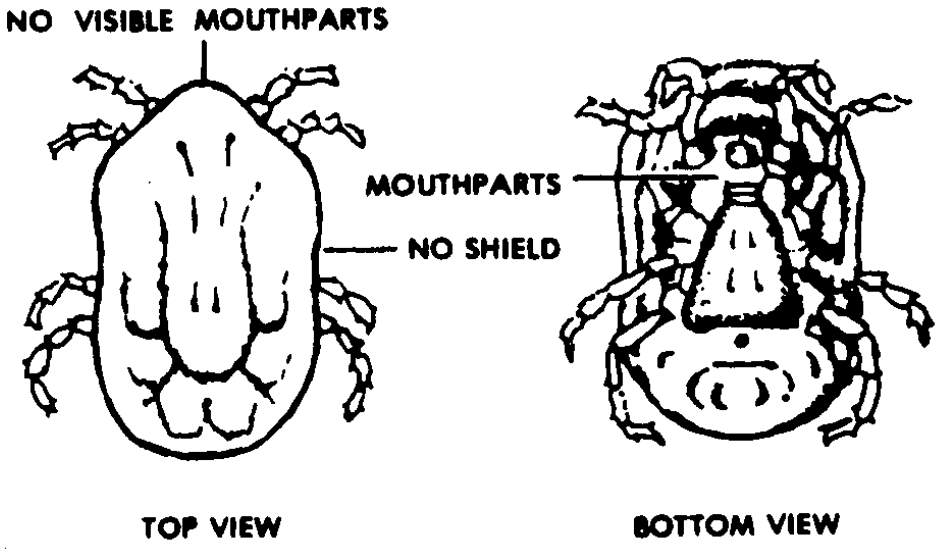

Figure 1-2. Adult soft ticks.

1-5. DISEASES TRANSMITTED BY TICKS

a. **Colorado Tick Fever Virus.** This virus has been referred to as "mountain fever" and was first noticed in the Bitter Root Valley of Montana where doctors in 1902 noted that febrile cases occurred without skin rash. The cause was shown to be a virus transmitted by ticks and is recognized as the only tick transmitted disease common in North America. Affecting victims in all the Rocky Mountain states, the Black Hills of South Dakota and western Canada, the disease is indicated by a sudden onset of fever, headache, retro-orbital pain, and severe muscle pains. The disease is frequently diphasic where the symptoms and the remission period last for 2 to 3 days. In the case of children, serious complications in the form of encephalitis and severe bleeding may occur; however, no lasting complications have been reported. Oregon and California have reported the infection in their states, also.

b. **Rocky Mountain Spotted Fever.**

(1) General. The Rocky Mountain spotted fever has been referred to as the Mexican spotted fever, Tobia fever, and the Sao Paulo fever; it has been recognized in the Bitter Root Valley of Montana since 1982. Many people call it "tick fever, black fever, blue disease, or black measles." It is a rickettsial disease that principally affects the endothelial cells of the small blood vessels. It is found in the United States (US), in some parts of Canada, in Mexico, and parts of South America, and it affects the population of those who have outdoor occupations (that is, agriculture). The infection follows a vicious chain. The tick feeds on an infected reservoir animal in any stage of the tick's life; larvae ingest this infected blood. The adult in turn passes the pathogen on through their eggs to the larvae of the next generation. Since crushed tick tissues and feces might produce infection, crushing ticks with fingernails can be dangerous.

(2) Signs and symptoms. A constant symptom is a rash observed about the second to the fifth day on the victim's wrists, ankles, and later spreading to all parts of the body. At first, the rash lesions are macular and pink, but later they become maculopapular and darker. The lesions become petechial in about 4 days. The victim suffers headaches (frontal and occipital), vomiting, myalgia, intense itching in the lumbar region, organ dysfunction, and marked malaise. The incubation period usually lasts 2 to 5 days but lasts 3 to 14 days for more severe infections. In the more virulent infections, the victim experiences 104-106ºF fever and death is usually between the ninth and fifteenth day.

(3) Treatment. The victim is administered broad-spectrum antibiotics such as tetracycline, chloramphenicol, chlortetracycline, or oxytetracycline. Parenteral fluids and oxygen may need to be administered.

c. **Relapsing Fever.**

(1) General. Relapsing fever is an acute infectious disease caused by several species of spirochetes, and the main reservoir is rodents. In March 1968, boy scouts camped near Spokane, Washington, in an old rodent-infested cabin and subsequently experienced the relapsing fever. This incident was the largest outbreak of tick-borne relapsing fever in the Western Hemisphere.

(2) Signs and symptoms. This fever causes the victim to abruptly experience fever 3 to 10 days after infection when there are large numbers of organisms present in the blood and in perhaps other body fluids. The victim suffers tachycardia, vomiting, arthralgia, severe headache, and often delirium. The fever subsides but after an afebrile period of 3 to 10 days, there is a second attack of fever and fewer organisms in the blood. These febrile attacks sometimes recur 3 to 10 times and in the case of epidemics, mortality can be as high as 50 percent but is generally low (0-5 percent).

(3) Treatment. The administration of procaine penicillin G, tetracycline, or erythromycin has proven effective.

d. **Tick Paralysis.** Tick paralysis was first attributable to ticks in Australia in 1843 when sheep and calves became paralyzed; however, a case was reported in Oregon when a child's motor and sensory nerves were affected. The child was unable to stand in the morning after retiring in good health, and on the third day was unable to swallow or speak. After two fully engorged ticks from the occipital region were removed, the child recovered within a week. Death is usually caused by respiratory failure. In the early stages, tick paralysis is painless and not much fever which is in contrast to poliomyelitis. Characteristically, a person experiences muscle weakness, lack of coordination, and ascending flaccid paralysis. Usually, these symptoms disappear once the tick is removed. Treatment of tick paralysis is symptomatic. Oxygen and respiratory assistance may be needed.

Section III. LOUSE-BORNE DISEASES

1-6. GENERAL

There are three species of lice which are of medical importance. These are the body louse, the head louse, and the crab louse. Lice are most commonly found in temperate and subarctic areas where people wear heavy clothing in several layers. When the body lice aren't feeding on a person's body, they remain in his clothing. Body lice are the primary vectors of disease which includes typhus fever and relapsing fever.

1-7. DISEASES TRANSMITTED BY LICE

a. **General.** Typhus fever (epidemic) is rickettsial disease which may survive in lymphoid tissues for many years; recurrence is possible (Brill's disease). Epidemic louse-borne typhus is caused by an infection with Rickettsia prowazekii, which is a parasite of the body louse. Ultimately, the parasite kills the louse. Transmission of this disease is prevalent in crowded living conditions, war, famine, or any kind of situation that predisposes heavy infestation of lice. If the louse sucks the blood of a victim infected, the organism starts growing in the gut of the louse and stays there. When the louse then has a blood meal off another victim, the louse defecates simultaneously, and the infected feces are rubbed into the bite wound when it itches. It is also possible for dry, infectious louse feces to enter the respiratory tract mucous membranes, causing human infection. Once the typhus patient has been bathed and deloused, he is no longer infectious for other humans.

b. **Signs and Symptoms.** Following an incubation period of 10-14 days, the patient begins to have chest pains, coughing, headache, and prodromal malaise. After this comes "influenzal symptoms" that progress to stupor and delirium. Other symptoms are flushed face, conjunctivitis, and rales at the lung bases. Following this is a macular rash (soon it is papular) appearing in the axillas, then the trunk and onto the extremities. The rash seldom goes to the face, palms, or soles. In nonepidemic conditions, the prodromal symptoms and the beginning febrile stage are not specific enough for diagnosis of typhus--sometimes even the rash is missing or difficult to see in dark-skinned patients.

c. **Treatment.** Tetracycline, parenteral fluids, and oxygen may be administered. A vaccine is available that gives good protection against severe disease; however, it does not prevent infection or mild disease. The best prevention of the disease is louse control with insecticides and frequent bathing.

NOTE: Another louse-borne disease is relapsing fever which was previously described under tick-borne diseases.

Section IV. FLEA-BORNE DISEASES

1-8. GENERAL

Fleas which attack humans live primarily on cats, dogs, and rodents. Rodent fleas are the vectors for the transmission of plaque and typhus fever (murine). When the normal rodent hosts are unavailable, rodent fleas will readily attack man. Plaque is transmitted through the bite of the infected flea. Typhus fever (murine) is transmitted when flea feces or crushed fleas are scratched into the skin.

1-9. DISEASES TRANSMITTED BY FLEAS

a. **Typhus Fever (Murine).**

(1) General. Typhus fever is a rickettsial disease similar to typhus fever (epidemic). The Rickettsial typhi (R. mooseri) is a parasite of rats that is transmitted from rat to rat by the rat flea. When a human is bitten by an infected flea, the human becomes infected because the flea released the infected feces while sucking blood.

(2) Signs and symptoms. The flea typhus is similar to Brill's disease because the onset is gradual. The rash and fever are also less severe than that found in louse-borne typhus. The rash concentrates on the trunk and disappears fairly rapidly. The flea typhus is a mild disease and rarely progresses into pneumonia or gangrene.

(3) Treatment. The same procedures used for typhus fever (epidemic) are applicable for typhus fever (murine).

(4) Prevention. To control rats and ectoparasites, insecticides are used for rat runs, colonies, and nests, and rats are trapped or poisoned.

b. **Plague (Bubonic Plague, Pneumonic Plague, Septicemic Plague, Pestis, "Black Death").**

(1) General. The plague (Yersinia pestis) is an acute febrile disease of wild and commensal rodents transmissible among these lower animal hosts, such as rats, mice, squirrels, and to man through the bite of infected ectoparasites. This infection may also be transmitted by droplets or sputum from a plague victim who has pneumonia. When the victim is bitten by an infected flea, the organisms go through the lymphatics to the lymph nodes causing them to become greatly enlarged (bubo). In this manner, the organisms may reach the bloodstream and affect all organs. The outcome is often fatal in cases where pneumonia or meningitis develops. The incubation period for bubonic plague is 2 to 6 days and for the pneumonic plague, it is 3 to 4 days.

(2) Signs and symptoms.

(a) The onset of bubonic plague is abrupt and often associated with chills. The temperature rises rapidly from 103º to 106ºF and his face shows fear and anxiety. Other signs include vomiting and the victim is thirsty. He has an unsteady gait, generalized pains, a headache, and mental dullness. His skin becomes hot and dry, his pulse and respiration rates increase, his face becomes edematous, and he has gastrointestinal (GI) and pulmonary hemorrhages. The buboes (enlarged, painful, tender lymph nodes) are commonly found in the femoral and inguinal nodes but less commonly in the axillary and cervical nodes.

(b) A patient suffering from pneumonic plague has a severe headache and an explosive onset of high fever (103º-106ºF). The disease involves the patient's pulmonary processes to include a bloody, frothy productive cough, dyspnea, tachypnea, plural pain or dull substernal oppression, rales, and impaired percussion. The other signs are chills and tachycardia. In the later stages of the disease, the patient has severe dyspnea, cyanosis, and heart failure.

(c) Septicemic plague is another form of plague. It usually comes on suddenly and with great severity to a patient suffering from bubonic plague. This form of plague may be fatal although the patient is also ill with bubonic plague.

(3) Treatment. If plague is suspected, begin therapy immediately. The treatment of choice is streptomycin, 30 mg/kg per day administered intramuscularly in 4 equal doses given every 6 hours. After this, give 0.5 g intramuscularly at 6-8 hour intervals. At the same time, administer tetracycline (2 g) orally, but if necessary, give it parenterally. If required, use IVs, pressor drugs, oxygen or a tracheostomy. Strict isolation techniques should be adhered to in cases of plague.

(4) Prevention and control. Extensive rodent and flea control measures are necessary, but it is rarely possible to achieve total eradication from rodents in endemic situations. For those individuals who are exposed to the risk of plague infection, temporary protection may be provided through the administration of tetracycline hydrochloride (500 mg orally 2-4 times daily for 5 days). Vaccines have been used for years; however, their effectiveness has not been clearly established.

Section V. MOSQUITO-BORNE DISEASES

1-10. CHARACTERISTICS

Most disease-carrying mosquitoes are found in milder climates and in the tropics. The female mosquitoes are the vectors of disease (transmit the causative organism of disease to a susceptive person). The more important diseases which are transmitted by mosquitoes include malaria, yellow fever, dengue fever, viral encephalitis, and filariasis. Malaria is the greatest threat to military operations, so lesson 4 will list details of this disease.

1-11. DISEASES TRANSMITTED BY MOSQUITOES

a. **Yellow Fever.**

(1) General. Yellow fever is an acute viral infectious disease transmitted by the Aedes and jungle mosquitoes. It is found in Africa and South America; however, some epidemics are found far into the temperate zone when the season is warm. The transmission occurs when a mosquito bites an infected person and then later bites a susceptible person (the virus multiplied in the mosquito's body).

(2) Signs and symptoms. The symptoms include nausea, vomiting, headache, malaise, retro-orbital pain, fever, photophobia, and possibly bradycardia. If the victim suffers the severe form of the disease, he experiences the above symptoms but also extreme prostration, petechiae and mucosal hemorrhages, severe pains throughout the body, jaundice, and oliguria. Some signs of this disease include erythematous face, tachycardia, conjunctival redness during the congestive phase, and on the third day, a period of calm. Just after the occurrence of the normal temperature, there is a return of fever, bradycardia, hemorrhaging, hypotension, jaundice, and later delirium.

(3) Treatment. The treatment consists of a liquid diet that limits food to high carbohydrate, high protein liquids; if required, a saline and glucose IV should be administered. Give sedatives and analgesics as necessary.

(4) Prevention. Mosquito control is the best preventive measure. Persons traveling to or living in endemic areas should obtain the highly effective live virus vaccine.

b. **Dengue Fever (Dandy Fever, Breakbone Fever).**

(1) General. This is a viral disease which is also caused by the Aedes mosquitoes. Dengue fever occurs during warm weather (the active mosquito season). One of several serotypes located between latitudes 25 degrees north and 25 degrees south may be responsible for this fever.

(2) Signs and symptoms. The victim experiences a sudden onset of high fever along with chills, and sore throat, depression, and prostration. There is also a severe aching ("breakbone") of his extremities, back, and head. Bradycardia and hypotension may also be present. For 3 or 4 days, there is the initial febrile phase, and this is usually followed by remission lasting from a few hours to two days. In approximately 80 percent of the cases, a skin eruption (maculopapular) appears during the remission or the second febrile stage. The symptoms during this stage are milder than those of the initial phase. In a high percentage of cases (mosquito-borne hemorrhagic fever) in Southeast Asia, hemorrhages (gastrointestinal) and petechial rashes occur. Until the skin eruption appears, it is difficult to distinguish dengue fever from malaria, yellow fever, or influenza.

(3) Treatment. For shock, it is necessary to expand the circulating blood volume. For discomfort, administer salicylates as necessary and allow a gradual restoration of activity during the prolonged convalescence.

c. **Encephalitis.**

(1) Viral encephalitis. Although arboviruses from mosquitoes, birds, or small rodents are the principal vectors, there are many other viruses that may produce encephalitis. The "masslike" lesions in the temporal lobes are caused by herpes simplex. The mumps virus, other enteroviruses, or poliovirus can be the cause of encephalitis. It is also produced by the rabies virus.

(2) Erythematous diseases. Erythematous diseases of childhood (measles, rubella, infectious mononucleosis, and varicella) may be accompanied by encephalitis.

(3) Result of vaccination. After the use of certain immunizing agents, encephalitis may occur. The vaccines to prevent pertussis, smallpox, and rabies are included in this group.

(4) Toxic encephalitis. This type may result from bacterial toxins, poisons, or drugs. It can be clinically indistinguishable from infectious encephalitis.

(5) Reyes' syndrome. This is a rare but severe complication of influenza or from other diseases such as parainfluenza virus, echovirus, or coxsackievirus. There is a rapid development of hepatic failure and encephalopathy. Reyes' Syndrome has a 30 percent fatality rate.

(a) Signs and symptoms. The victim of encephalitis has fever, sore throat, nausea, vomiting, malaise, stupor, lethargy, coma, and convulsions. The signs of encephalitis include tremors, convulsions, stiff neck, cranial nerve palsies, meningeal irritation, paralysis of extremities, absent superficial reflexes, pathologic reflexes, and exaggerated deep reflexes.

(b) Treatment. A variety of procedures may ensure a successful outcome although specific therapy is not available. The reduction of intracranial pressure (by using mannitol or a urea), con-trolling convulsions, administration of oxygen, maintenance of the airway, and providing adequate nutrition during prolonged coma are measures that have proven to be effective. The conventional IV nutrition may continue for 72 hours, but must be replaced by a nasogastric tub or intestinal feedings. It is important to begin treatment early for prevention of decubiti, urinary tract infection, and pneumonia. If necessary, administer anticonvulsants.

d. **Filariasis.**

(1) General. Filariasis is a diseased state caused by the presence of filariae within the body. The infection is caused by filarial worms that stay in the lymphatic system and produce recurrent lymphangitis with obstruction and fibrosis. There are two possible filarial nematodes that cause filariasis. The transmission of the infective larvae of the Brugia malayi nematode to humans is due to a bite from certain Mansonia or Anopheles mosquito. These mosquitoes are found in south India, south China, Southeast Asia and Ceylon. On the Pacific Islands and in the tropics and subtropics of both hemispheres, the Wuchereria bancrofti nematode (found only in humans) is transmitted from human to human by certain Culex and Aedes mosquitoes.

(2) Signs and symptoms. At the beginning of filariasis, there is inflammation, but in later stages, it progresses to obstruction in the lymphatic system. The victim experiences episodes of fever and the inflammatory lymphatitis and nodes that flare up at irregular intervals.

(3) Treatment. For the febrile and local inflammatory occurrences, bed rest is indicated. For secondary infections (abscesses over inflamed nodes), antibiotics should be administered. A palliative measure used for orchitis (inflammation of the testis), epididymitis (inflammation of the elongated cordlike structure along the posterior border of the testis), and scrotal lymphedema, a suspensory bandaging may be used. Mild edema of a limb may be treated with rest, elevation, and by an elastic stocking. In cases of elephantiasis (inflammation and enlargement of the part), the surgical removal of the breast, scrotum or vulva is easy and usually satisfactory. Limb elephantiasis is not easy and meets with disappointing results. The drug of choice is diethylcarbamazine which is given orally 3 times daily after meals for 21-28 days. The dosage is usually 2 mg of citrate per body weight. The microfilaria are destroyed; however, there is only limited action on the adult worms. If the victims leaves the endemic area with only a mild case, his prognosis is good.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS. Answer the following exercises by writing the word or words in the space that properly completes the sentence or best answers the question.

After you have completed all of these items, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced after the answer.

1. Any of the insects, arachnids, or crustaceans that consist of a jointed body and limbs with the brain dorsal to the alimentary canal and connected with a ventral chain of ganglia is called an _____.

2. What does a reservoir refer to in this lesson? _____

   _____

3. How are arthropod-borne diseases transmitted? _____

   _____

4. What is the organism from which a parasite obtains its nourishment called?

   _____

5. What is autoinfection? _____

   _____

6. How do houseflies transmit diseases? _____

   _____

7. What is dysentery? _____

   _____

8. Meningismus, coma, and _____ occur in the most severe cases of dysentery.

9. As the dysentery progresses, _____, weakness and a tender abdomen follow.

10. The antibiotic of choice for treating dysentery is _____

11. If cramps from dysentery are severe, _____ may be helpful.

12. _____ is caused by Vibrio cholerae which are transmitted by food or drink that is contaminated by feces containing a large number of vibrio.

13. In the treatment of cholera, the losses of _____ and _____ must be restored immediately and continuously.

14. _____ is given orally every 6 hours for 3-5 days in the treatment of cholera.

15. If the cholera victim receives prompt and competent treatment, the mortality rate can be reduced to 1 percent from an untreated rate of _____.

16. You must notify the _____ if a patient is suspected of having cholera.

17. Where high standards of sanitation and public health exist, there is rarely an outbreak of _____ any significant size.

18. Chronic carriers with persistent gallbladder or urinary tract infections are the main source of most _____ infections.

19. If untreated, typhoid fever can be divided into three stages: _____, _____ and the _____.

20. There are complications from typhoid fever in approximately____ percent of the untreated cases and these account for 75 percent of the deaths from typhoid fever.

21. What type of individuals should be immunized for typhoid? _____

_____

_____

22. If the infection causing typhoid is resistant to ampicillin and chloramphenicol, _____ mixtures may be effective.

23. Ticks are divided into two groups: _____ ticks and _____ticks.

24. If the individual is bitten by a tick, he is subject to an _____ virus, _____ virus, _____ virus, or _____ virus which the tick can transmit through the bite.

25. In the case of children, serious complications from the Colorado tick fever virus is a form of _____, and _____ _____ may occur.

26. Rocky Mountain spotted fever has been referred to as the _____, _____, and the _____.

27. Individuals who have _____ occupations are affected by the Rocky Mountain spotted fever.

28. Crushing ticks with _____ can be dangerous because the crushed tick tissues and feces might produce infection.

29. A victim of the Rocky Mountain spotted fever suffers _____, _____, _____, _____, _____, and _____.

30. Medications prescribed for the treatment of Rocky Mountain spotted fever include _____, _____, _____, or _____.

31. Relapsing fever is an acute infectious disease caused by several species of spirochete, and the main reservoir is _____.

32. The largest outbreak of tick-borne relapsing fever in the Western Hemisphere occurred in March 1968 near _____, _____.

33. An effective medication in the treatment of relapsing fever is _____, _____, or _____.

34. The three species of lice that are of medical importance are the _____, the _____ louse, and the _____ louse.

35. Body lice are the primary vectors of disease that includes _____ and _____.

36. Once the typhus patient has been _____ and _____, he is no longer infectious for other humans.

37. A vaccine for typhus fever is available and it gives good protection against severe disease; however, it does not _____ or _____.

38. Rodent fleas are the vectors for the transmission of _____ and _____.

39. Plague may be transmitted through the bite of a flea, but the infection may also be transmitted by _____ or _____ from a plague victim who has pneumonia.

40. Medication used in the treatment of plague is _____.

41. The more important diseases that are transmitted by mosquitoes include _____, _____, _____, _____, and _____.

42. The mosquito-borne disease which is the greatest threat to military operation is _____.

43. Yellow fever is an acute viral infectious disease transmitted by the _____ and _____ mosquitoes.

44. The symptoms of yellow fever include _____, _____, _____, _____, _____, _____, _____, _____, and _____.

45. The _____ victim experiences a sudden onset of high fever along with chills and sore throat, depression, and prostration.

46. Other viruses that may cause viral encephalitis (in addition to the disease contacts through mosquitoes, birds, or small rodents) include _____, _____, _____, _____, or _____.

47. The victim of encephalitis has _____, _____, _____, _____, _____, _____, _____, _____, and _____.

48. At the beginning of filariasis, there is inflammation but in later stages, it progresses to obstruction in the _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. Arthropod. (para 1-1)
2. The reservoir is the source of the arthropod-borne disease. (para 1-1)
3. The vector transmits the causative organisms of disease to a susceptible person. (para 1-1)
4. Host. (para 1-1)
5. An infection by bacteria that is present within one's own body. (para 1-1)
6. On their hairs, in their feces and vomitus. (para 1-2a)
7. A term applied to a number of intestinal disorders (especially of the colon) that is characterized by inflammation of the mucous membranes. (para 1-3a(1))
8. Convulsions. (para 1-3a(2))
9. Dehydration. (para 1-3a(2))
10. Ampicillin. (para 1-3a(3))
11. Antispasmodics. (para 1-3a(3))
12. Cholera. (para 1-3b(1))
13. Water; electrolytes (para 1-3b(3))
14. Tetracycline. (para 1-3b(3))
15. 80 percent. (para 1-3b(3))
16. Health Department. (para 1-3b(3))
17. Cholera. (para 1-3b(4))
18. Typhoid. (para 1-3c(1))
19. Prodromal, fastigium, and the stage of defervescence. (para 1-3c(2))
20. 30. (para 1-3c(3))

21. Immunizations should be provided for household contacts of a typhoid carrier, for people traveling to endemic areas, and during any epidemic outbreaks. (para 1-3c(4))

22. Trimethoprim-sulfonamide. (para 1-3c(5))

23. Hard; soft. (para 1-4)

24. Encephalitis; hemorrhagic fever; Colorado tick fever; Rocky Mountain spotted fever. (para 1-4)

25. Encephalitis; severe bleeding. (para 1-5a)

26. Mexican spotted fever, Tobia fever; Sao Paulo fever. (para 1-5b)

27. Outdoor. (para 1-5b)

28. Fingernails. (para 1-5b(1))

29. Headaches, vomiting, myalgia, intense itching in the lumbar region, organ dysfunction, and marked malaise. (para 1-5b(2))

30. Tetracycline, chloramphenicol, chlortetracycline, or oxytetracycline. (para 1-5b(3))

31. Rodents. (para 1-5c(1))

32. Spokane, Washington. (para 1-5c(1))

33. Procaine penicillin G, tetracycline, or erythromycin. (para 1-5c(1))

34. Body; head; crab. (para 1-6)

35. Typhus fever; relapsing fever. (para 1-6)

36. Bathed and deloused... (para 1-7a)

37. Prevent infection or mild disease. (para 1-7c)

38. Plague and typhus fever (murine). (para 1-8)

39. Droplets or sputum. (para 1-9b(1))

40. Streptomycin. (para 1-9b(3))

41. Malaria, yellow fever, dengue fever, viral encephalitis, and filariasis. (para 1-10)

42. Malaria. (para 1-10)

43. Aedes and jungle... (para 1-11a(1))

44. Nausea, vomiting, headache, malaise, retro-orbital pain, fever, photophobia, and possibly bradycardia. (para 1-11a(2))

45. Dengue fever... (para 1-11b(2))

46. Herpes simplex, mumps virus, other enteroviruses, poliovirus, or rabies virus. (para 1-11c(1))

47. Fever, sore throat, nausea, vomiting, malaise, stupor, lethargy, coma, and convulsions. (para 1-11c(5)(a))

48. Lymphatic system. (para 1-11d(2))

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Animal-Borne Diseases.
LESSON ASSIGNMENT	Paragraphs 2-1 through 2-8.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

2-1. Identify rabies disease, its signs and symptoms, its treatment, and prevention.

2-2. Identify leptospirosis disease, its signs and symptoms, its treatment, and prevention.

2-3. Identify brucellosis disease, its signs and symptoms, its treatment, and prevention.

2-4. Identify anthrax disease, its signs and symptoms, its treatment, and prevention.

2-5. Identify Q-fever disease, its signs and symptoms, its treatment, and prevention.

2-6. Identify tularemia disease, its signs and symptoms, its treatment, and prevention.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

ANIMAL-BORNE DISEASES

2-1. GENERAL

Zoonotic diseases are diseases that are common to animals, but can be transmitted to man. For this reason, these diseases have been a menace to man throughout history. The pet you love so much could be a host for diseases which are very dangerous to mankind. In this lesson, you will learn to identify some of the zoonotic diseases with which you may come into contact. With an awareness of these diseases, their general characteristics, modes of transmission, and clinical findings, you will be alert for either treatment or prevention. The more important zoonotic diseases include rabies, leptospirosis, brucellosis, anthrax, Q-fever, and tularemia.

2-2. RABIES (HYDROPHOBIA)

Rabies is an acute infectious disease of the central nervous system to which all warm-blooded animals, including man, are susceptible. It is a viral encephalitis which is transmitted when infected saliva gains entry into the body by a bite through an open wound. The host range for this disease is both the carnivorous and chiropterna (bat) species to include skunks found in the Midwest and California, foxes found in the east and southeast, raccoons from Florida and Georgia, bats found in the entire US, and occasionally, there are cases in which coyotes, bobcats, wolves, and squirrels are rabid. Domestic animals that are hosts for rabies are dogs, cats, cows, pigs, horses, and mules. The virus travels in the nerves to the brain, multiplies, and then migrates along the efferent nerves to the salivary glands. The incubation period is variable. It is usually between two and eight weeks, but can vary from 10 days to eight months.

a. **Signs and Symptoms.** The prodromal phase lasts from two to four days, and the patient suffers headache, a slight temperature elevation from 1-3ºF, malaise, nervousness, and abnormal sensation around the site of the bite. During the excitation phase (predominant phase up to the time of death), the victim has dilated pupils, lacrimation, excessive perspiration, loss of swallowing reflex, excess salivation (frothy), a fear of water (hydrophobia), increased apprehension, anxiety, insomnia, and maniacal seizures.

b. **First Aid Treatment.** When the victim is bitten, wash the wound immediately with copious amounts of saline and cleanse the area with large amounts of soap and water. After this, thoroughly rinse with large amounts of saline and drown the wound with 1-2 percent benzalkonium chloride. If necessary, debride the wound and administer tetanus toxoid. It is generally not advised to perform immediate suturing.

c. **Coordination of the Bite Case.** The bite should be reported to the local authorities. The animal bite report should be completed in the emergency room on the initial treatment and copies of the report sent to the Rabies Advisory Board, the post veterinarian, and to the provost marshal. The report should provide a description of the circumstances surrounding the bite, the species of the offending animal (very important), and if the bite resulted from a provoked or nonprovoked attack. It must be established if the animal was disturbed while eating, or if the bite occurred during actions that an animal might interpret as threatening. It is important to know if the bite occurred while there was involvement with the animal's offspring, while attempting to capture a wild animal, or in a case where the animal was defending its territory.

d. **The Biting Animal.** If the bite resulted from a domestic animal (dog or cat), the animal should be captured, confined, and observed by a veterinarian for a 10-day quarantine. The vaccination status of the animal must be verified. Much depends upon the location of the wound, the length of time before first aid was given, and the quality of the first aid. In the case of wild animal bites, attempts should be made to capture the animal, sacrifice it, and ship the head (iced) to the nearest laboratory that is qualified to make a determination if the animal was rabid. If the animal cannot be examined, it should be presumed to be rabid.

e. **Treatment.** Based on the recommendations of the US Public Health Service Advisory Committee and upon study of the circumstances of the bite, the physician decides the best course of treatment to follow.

f. **Prevention and Control of Rabies.** Public education is necessary to inform the population about this very severe illness that has an almost universal fatal outcome. Once the symptoms appear, death inevitably occurs after 2-3 days either from cardiac or respiratory failure or generalized paralysis. Owners should ensure that their pets are vaccinated on a timely basis and pets should be confined or walked on a leash. Some states have very heavy fines for pets unleashed while others are very lax and leave this requirement up to the owner. It is not wise to pick up loose pets and strays because they could be rabid, but appear to be in good shape for the time being. For high-risk individuals (veterinarians, animal handlers), pre-exposure prophylaxis with vaccine must be considered. The contact potential between wildlife and domestic animals should be reduced.

2-3. LEPTOSPIROSIS. (WEIL'S DISEASE, HEMORRHAGIC JAUNDICE, MUD FEVER, CANICOLA FEVER, SWINEHARD'S DISEASE)

a. **General.** Leptospirosis is a bacterial disease of wildlife and domestic animals, and occurs in man only incidentally after exposure to these species or to an environment contaminated by them. This disease is an occupational hazard to rice field workers, farmers, and military troops. It is an acute and often severe infection affecting the liver or other organs. Symptoms include meningeal irritation and hepatic disturbance. The most common reservoirs are rats, dogs, and cattle and swine. The incidence of leptospirosis is higher than usually supposed. The Leptospira icterohemorrhagiae found rats causes the most severe illness. These organisms can remain in culture contaminated soil for 43 days, and in urine contaminated soil for 15 days.

b. **Modes of Transmission.** There have been outbreaks among swimmers who have been exposed to water contaminated by the urine of domestic or wild animals such as cattle, dogs, swine, rodents, deer, foxes, reptiles, and amphibia (frogs). The disease can occur through contact of abraded skin with water, moist soil, or vegetation contaminated with the urine of infected animals. Leptospirosis is an occupational hazard for sugar cane field and rice workers, sewer workers, veterinarians, miners, dairymen, fish workers, farmers, animal husbandmen, abattoir workers, and military men. It is more apt to occur in those areas of the world where agriculture is less mechanized than North America, or where more intimate contact with livestock occurs. It is also a recreational hazard to campers, bathers, and sportsmen in infected areas. Person-to-person transmission is rare. The organisms may be excreted in the urine up to 11 months. The most common form of transmission in the US is from animal bites, close contact with the animal's droplets, transmission by aerosolized urine, infected carcasses/tissues, and by ixodial ticks. Since pets (dogs) have assumed a greater role in peoples' lives, the possibility of infection is ever present.

c. **Signs and Symptoms.** In the first or leptospiremic phase lasting from 4 to 9 days, the victim has chills, usually a frontal headache, severe muscle aches, a high spiking temperature (102ºF or more), anorexia, nausea and vomiting, and conjunctival suffusion. The second or immune phase lasts from 6 to 12 days with meningeal irritation, hepatic disturbance (jaundice or hepatic enlargement), skin rash (erythematous lesions), and myocarditis. There may be renal manifestations, such as proteinuria or hematuria.

d. **Treatment.** The administration of penicillin G (penicillin) dihydrostreptomycin, or tetracycline hydrochloride within the first few days seems to decrease severity. The primary supportive care is to hospitalize the patient, provide bed rest, and give meticulous fluid and electrolyte therapy.

e. **Method of Control.**

(1) Preventive measures.

(a) Provide boots and gloves for workers in occupations that are susceptible to the disease.

(b) Drain potentially contaminated water and soil.

(c) Provide public education explaining how the disease is transmitted, explaining how to provide protection if working in area where the disease may be prevalent, and apprising the public of the possibility of contacting the disease when swimming or wading in potentially contaminated waters.

(d) Control rodents, especially in rural and recreational habitations. Before harvest, fire cane fields.

(e) Isolate infected domestic animals in order to prevent the contamination of the working, living, and recreational areas.

(f) Isolate and test new stock; know the vaccination history.

(g) Control runoff from feedlots and barnyards.

(h) Provide adequate water treatment and disinfection.

(i) Prevent disease by immunizing farm and pet animals.

(j) Immunize workers. (Human immunization has been provided for workers in Japan, Spain and Italy.)

(2) Patient control (contacts and immediate environment).

(a) Notify the local health authority when the disease is contacted.

(b) Investigate to determine where the disease was contacted; close suspected pools or swimming holes.

(c) Provide high dosage of penicillin, streptomycin, tetracycline, or erythromycin early on. In case of renal failure, peritoneal or renal dialysis may be required.

2-4. BRUCELLOSIS (MEDITERRANEAN FEVER, MALTA FEVER, UNDULANT FEVER, BANG'S DISEASE)

a. **General.** Brucellosis is a widespread infectious, febrile disease affecting principally ruminants, cattle, swine, and goats, but sometimes affecting other animals (dogs, raccoons, opossums), including man. Brucellosis occurs worldwide and in particular, the Mediterranean countries of Europe and North Africa, Mexico, Central Asia and South America. It, too, is an occupational disease and occurs principally among males who are farm workers, abattoir workers, or veterinarians. These people work with infected animals or their tissues; therefore, they are more prone to the disease than others. Occasionally, the disease occurs among users of unpasteurized milk, or other milk products such as cheese. In the US, approximately 170 cases are reported annually. It is most prevalent in rural areas. Airborne infection may occur among animals in pens and stables. The incubation period is highly variable and difficult to ascertain, but it is usually 50 to 21 days (sometimes several months).

b. **Signs and Symptoms.** This systemic disease has an acute or insidious onset that may be very sudden. The patient experiences chills and fever, a severe headache, profuse sweating, generalized aching, malaise, arthralgia, weakness, and depression. His temperature increases as the disease progresses (104ºF-106ºF). Uncommon but characteristic features are orchitis and vertebral osteomyelitis. Although recovery is usual, there are pronounced disabilities, and the syndrome may reappear as relapses.

c. **Treatment.** The drug of choice in the treatment of brucellosis is tetracycline HCl (Tetracyn); however, for the seriously ill victim or those with abscesses, administer streptomycin. Steroids may be given to decrease systemic toxicity. Activity should be restricted in chronic cases and enforced bed rest during febrile periods.

d. **Prevention.**

(1) It is necessary that farmers and workers be educated as to the nature of the disease and shown ways of handling products or carcasses of potentially infected animals.

(2) Use serological testing to search for and eliminate infected animals. In cases of high prevalence in areas, immunize calves and sometimes adult animals.

(3) Ensure that milk and dairy products are pasteurized. If this is not possible, boil the milk.

(4) Caution the public not to partake of untreated milk and milk products.

(5) Disinfect contaminated areas. Use care when handling placenta, discharges, and fetus from aborted animals (protective clothing, rubber gloves).

(6) Inspect meat.

e. **Control.**

(1) Report cases to the local health authority.

(2) Disinfect purulent discharges concurrently.

(3) Treat animals if brucellosis is suspected--investigate for source of infection.

(4) Provide pasteurization of milk and milk products or stop the distribution of them.

(5) Control the transport of animal products and domestic animals.

2-5. ANTHRAX

a. **General.** Anthrax (malignant pustule, wool sorter's disease) is an acute bacterial disease of wild animals, especially ruminants. It usually affects the skin, but rarely involves the mediastinum or intestinal tract. In industrial countries, there are infrequent and sporadic outbreaks, but it is primarily an occupational hazard of processors of animal hair, hides, bone, bone products, or wool. Veterinarians and agricultural workers who handle infected animals are also subjected to anthrax. The spores of B. anthraces may stay viable in contaminated soil after the source--animal infection--has been terminated. These spores are very resistant to disinfection. In addition to contact with animal tissues, anthrax may be transmitted through contaminated wool, hair, hides, or even by-products made from them (brushes, drums, and so forth). The ingestion of contaminated meat causes intestinal anthrax, and the disease can be spread by contaminated feed to omnivorous and carnivorous animals. Organisms have even spread to other areas by vultures.

b. **Signs and Symptoms.**

(1) The cutaneous form. This type of anthrax affects the victim's hands, arms, neck, or face. The skin lesions are small erythematous (red-brown) papules that become vesicular, necrotic, and covered with a dark crust or eschar. The disease is characterized by an intense nonpitting edema, pruritus, a lack of tenderness, and mild regional lymph node enlargement. If untreated, the fatality rate is 5 percent to 20 percent, but with antibiotic administration, few deaths occur.

(2) The inhalation form of anthrax. The dust-containing spores that the person inhaled are deposited in the lung alveoli; then they spread through the lymphatics causing bacteremia or toxemia. In the beginning, the symptoms are mild, non-specific, and resemble a common upper respiratory infection. Following this however, there are more acute symptoms of respiratory distress and mediastinal widening (shown on x-rays). Fever and shock follow in 3 to 5 days, and death occurs shortly.

(3) Intestinal anthrax. Although this form of anthrax is rare and also difficult to recognize, it has a tendency to occur in explosive outbreaks. The victim suffers abdominal distress, fever, and signs of septicemia with death following in typical cases.

c. **Treatment.** The drug of choice used in treating anthrax is penicillin G (penicillin). Tetracycline HC1 (Tetracyn) or another broad-spectrum antibiotic may also be used.

d. **Prevention.**

(1) High-risk personnel should be immunized with a cell free vaccine. This vaccine is prepared from a culture filtrate that contains the protective antigen and protects personnel in preventing cutaneous and probably inhalation anthrax.

(2) Educate the personnel who handle potentially contaminated articles about modes of anthrax transmission. Stress personal cleanliness.

(3) Ensure proper ventilation and dust control in those industries where raw animal fibers are handled. In cases of suspicious skin lesions, have employees seek medical care and continue the medical supervision of all personnel. Provide adequate facilities for washing and changing clothes after work. Employees should use protective clothing during working hours).

(4) Wash and sterilize hair, hides, wool, bone meal, or other feed prior to processing.

(5) If an animal has been exposed to anthrax, do not seek the hides or use the carcasses for food or feed supplements.

(6) When the first animals die of suspected anthrax, conduct a postmortem examination and take care not to contaminate the soil or environment with infected tissues or blood. Burn the carcasses or prepare a deep burial in the exact place of death (use anhydrous calcium oxide (quick lime). Use a 5 percent solution of lye for decontaminating soil that was seeded with the animal's bodily discharges.

(7) Vaccinate immediately all animals at risk. Use penicillin or tetracyclines for symptomatic animals.

(8) Perform an annual vaccination of animals in enzootic areas.

(9) Use control of trade wastes and effluents from rendering plants that handle potentially infected animals.

e. **Control.**

(1) Report cases to the local health authority.

(2) Isolate wounds until anthrax bacilli free. Place inhalation cases under strict isolation.

(3) Perform terminal cleaning of area.

(4) Determine source of infection--investigate all contacts. Ensure adequate preventive measures in manufacturing plants.

2-6. PLAGUE

This acute febrile disease was explained in paragraph 1-9b.

2-7. Q-FEVER (QUERY FEVER)

a. **General.** Q-fever is self-limited rickettsial disease that is caused by the infectious agent, Coxiella burnetii (Rickettsia burnetii). It has been reported worldwide, and the incidence is even greater than reported. This disease affects meat workers, farmers, veterinarians, and dairy workers. It has also affected personnel working in diagnostic laboratories and in medical centers where sheep, are used for research. The natural reservoir for this disease is ticks, wild animals, cattle, sheep, and goats. Q-fever may be transmitted by airborne dissemination in dust (organisms may be carried downwind half a mile or more) or by ingestion of infected raw milk. Person-to-person transmission is very rare, but may occur through direct contact with the laundry of exposed persons.

b. **Signs and Symptoms.** The onset is abrupt with fever, severe headache, chilliness, severe malaise, myalgia, and chest pains all varying in severity and duration. The victim's fever may rise to 40ºC (104ºF) and persist from one to more than three weeks. A nonproductive cough with evidence of pulmonitis occurs during the second week. There have been reports of pericarditis, chronic endocarditis, hepatitis, and generalized infections. If the victim has damaged heart valves or valve replacements, chronic Q-fever may result.

c. **Treatment.** The specific antimicrobial therapy directed against the offending rickettsial agents consists of tetracycline HCl (Tetracyn) which is the drug of choice or chloramphenicol (Chloromycetin) which is effective. Chloramphenicol is used only if tetracyclines are not available. It is not recommended because of the possibility of an occasional complication of aplastic anemia. Supportive measures should be taken to correct physiologic abnormalities and good nursing care should be provided since these actions may be lifesaving in severe cases.

d. **Prevention.** Maintain strict hygienic measures in cow and sheep barns, sheds, and laboratories. Ensure hygienic practices (pasteurization of milk). Educate personnel who work in environments where Q-fever may occur. If pasteurization of milk from cows, goats, or sheep is not possible, boil the milk at 71.7ºC (161ºF) for 15 seconds. Immunize those workers in hazardous occupations. Maintain dust control in pertinent industries. Incinerate animal placentas, feces, and urine. Isolate victims and autoclave their used articles that contained sputum and urine.

2-8. TULAREMIA (RABBIT FEVER, DEER-FLY FEVER, OHARA'S DISEASE)

a. **General.** Tularemia is an acute, plague-like infectious disease of wild animals and man. It is caused by Francisella tularensis, a gram-negative bacteria. Primary centers from which the disease develops have been identified in Canada, the United States, Mexico, and Russia. The disease is found also in most European countries as well as Turkey, Iran, China, Japan, and Tunisia. The disease is transmitted in a variety of ways. People can contact tularemia by handling wild rabbits and rodents such as muskrats who are infected. Drinking water from a stream on whose banks an infected wild animal has died is another mode of transmission. Other ways of transmission include inhaling dust from a substance (hay, for example; contaminated with infected animal feces); contact with a domestic animal who is serving as an accidental host; contact with infected ticks or other arthropods; and ingesting infected, cooked meat.

b. **Signs and Symptoms.** Epidemics of tularemia have occurred in the United States and Russia, but usually there are only occasional cases. The incubation period is from two to 10 days, usually 3 days. General signs and symptoms include headache, chills, nausea, vomiting, temperature between 103º and 104ºF, and severe prostration. There are several clinical forms of tularemia; the form is determined by the portal of entry of the agent causing the disease.

(1) Ulceroglandular tularemia. This is the most common form in the United States. At the point of entry (arthropod bite, scratch by contaminated nails, or knife cut), a lesion occurs; later this lesion develops into a necrotic ulcer with swelling of the regional lymph nodes. The lymph node often suppurates and ulcerates. If the disease is untreated, it lasts from three to five weeks. Convalescence, then, can last several weeks or months with the patient having fever from time to time.

(2) Glandular tularemia. This is the same form of disease as ulceroglandular tularemia. The difference is that the primary lesion does not occur.

(3) Oculoglandular tularemia. This disease develops when contaminated material reaches the conjunctiva. The primary lesion occurs on the lower eyelid. This lesion consists of an ulcerated papula with a swelling of the regional lymph node.

(4) Pulmonary tularemia. Farm workers or laboratory workers are affected by this form of tularemia. It is caused by those people inhaling particles in the air. These particles caused pneumonia in humans. It should be noted that a little less than one third of those having tularemia of any kind develop bronchopneumonia.

(5) Typhoid tularemia. People contract this disease by eating food that is contaminated, usually the meat of infected wild rabbits. The disease can also be contracted by drinking contaminated water. These are the symptoms: gastroenteritis, fever, toxemia, ulcerative lesions in the mucosa of the mouth, pharynx, and the intestines. Sometimes the cervical, pharyngeal, and lymph glands swell.

c. **Treatment.** Two methods of treatment are usual. First, the drug streptomycin, the drug of choice, can be administered. Second, put a wet saline dressing on the primary lesions.

d. **Prevention and Control.** These measures are useful in preventing this disease in humans.

(1) Use repellent and protective clothing to prevent ticks or other arthropod bites.

(2) Search for ticks frequently and remove them immediately.

(3) Use gloves when handling and skinning wild animals.

(4) Don't drink untreated water in areas where tularemia is suspected. Disinfect the water before drinking it.

(5) Be sure meat from wild game and birds is thoroughly cooked before eaten.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS. Answer the following exercises by writing the word or words in the space that properly completes the sentence or best answers the question.

After you have completed all of these items, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced after the answer.

1. What are zoonotic diseases? _____

   _____

2. The more important zoonotic diseases include _____, _____, _____, _____, _____, and _____.

3. An acute infectious disease of the central nervous system to which all warm-blooded animals and man are susceptible is _____.

4. Domestic animals that are hosts for rabies are _____, _____, _____, _____, _____, and _____.

5. During the excitation phase, the victim of rabies has _____ pupils, _____, _____, excessive _____, loss of swallowing reflex, excess _____ (frothy), and other signs and symptoms.

6. An animal bite report should be completed in the emergency room on the initial treatment and copies of the report sent to the _____, _____, and to _____.

7. In cases of animal bites, it must be determined if the animal was disturbed while _____ or during actions that an animal might interpret as _____.

8. If a domestic animal bites, the animal should be _____, _____, and _____ by a veterinarian for a 10-day quarantine.

9. When a person is bitten, much depends upon the _____ of the wound, the _____ before first aid was given, and the _____ of the first aid.

10. If a person is bitten by a wild animal, attempts should be made to _____ the animal, _____ and ship the _____ to the nearest laboratory that is qualified to make a determination if the animal was rabid.

11. Once the symptoms of rabies appear, death inevitably occurs after 23 days either from _____ or _____ failure, or from generalized _____.

12. Owners should ensure that their pets are _____ on a timely basis, and pets should be confined or _____.

13. What is leptospirosis? _____

_____

_____

14. Leptospirosis, is an acute and often severe infection affecting the _____ or other organs.

15. The Leptospira icterohaemorrhagiae found in _____ causes the most severe illness of leptospirosis.

16. There have been outbreaks of leptospirosis among _____ who have been exposed to water contaminated by the urine of domestic or wild animals.

17. Leptospirosis is an occupational hazard for sugar cane field and rice workers, _____, _____, _____, _____, _____, _____, _____, _____, and _____

18. Leptospirosis is a recreational hazard to _____, _____, and _____ in infected areas.

19. In the US, the most common form of transmission of leptospirosis is from _____, _____, _____, _____, _____, and _____

20. List three ways a person can contract tularemia.

    a. _____.

    b. _____.

    c. _____.

21. List four general symptoms of tularemia.

    a. _____.

    b. _____.

    c. _____.

    d. _____.

22. Name three methods/ways a person can protect himself from tularemia.

    a. _____.

    b. _____.

    c. _____.

23. The drug usually given to tularemia patients is _____.

24. Another treatment generally used for tularemia patients is _____

    _____.

25. The primary supportive care for victims of leptospirosis is to _____,

    _____, and _____.

26. One method of control of leptospirosis is to provide _____ and

    _____ for those workers in occupations that are susceptible to the

    disease.

27. Define brucellosis. _____

    _____

    _____.

28. Occasionally, brucellosis occurs among users of _____ or _____ such as cheese.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. Zoonotic disease are diseases that are common to animals but diseases which can be transmitted to man. (para 2-1)

2. Rabies, leptospirosis, brucellosis, anthrax, Q-fever, tularemia. (para 2-1)

3. Rabies. (para 2-2)

4. Dogs, cats, cows, pigs, horses, mules. (para 2-2)

5. Dilated, lacrimation, perspiration, salivation. (para 2-2a)

6. Rabies Advisory Board, post veterinarian, provost marshal. (para 2-2c)

7. Eating, threatening. (para 2-2c)

8. Captured, confined, observed. (para 2-2d)

9. Location, length of time, quality. (para 2-2d)

10. Capture, sacrifice it, the head (iced). (para 2-2d)

11. Cardiac, respiratory, paralysis. (para 2-2f)

12. Vaccinated, walked on a leash. (para 2-2f)

13. Leptospirosis is a bacterial disease of wildlife and domestic animals. The disease occurs in humans only incidentally after exposure to these species or to an environment contaminated by them. (para 2-3a)

14. Liver. (para 2-3a)

15. Rats. (para 2-3a)

16. Swimmers. (para 2-3b)

17. Sewer workers, veterinarians, miners, dairymen, fish workers, farmers, animal husbandmen, abattoir workers, military personnel. (para 2-3b)

18. Campers, bathers, sportsmen. (para 2-3b)

19. Animal bites, close contact with the animal's droplets, transmission by aerosolized urine, infected carcasses/tissues, ixodial ticks. (para 2-3b)

20. Any three of the following five ways are correct.

    Handling wild rabbits and rodents who are infected.
    Drinking contaminated water.
    Inhaling animal feces infected dust.
    Handling a domestic animal who is an accidental host.
    Eating infected meat not thoroughly cooked. (para 2-8a)

21. Any four of these symptoms are correct.

    Headache.
    Chills.
    Nausea.
    Vomiting.
    Temperature between 103 degrees and 104 degrees Fahrenheit.
    Severe prostration. (para 2-8b)

22. Any 3 of these five ways are correct.

    Wear repellent and protective clothing to prevent bites.
    Look often for ticks and remove them immediately.
    Wear gloves when handling wild animals and skinning them.
    Disinfect water before drinking it in an area where tularemia is suspected.
    Be sure meat from wild game and birds is thoroughly cooked before eating it. (para 2-8d)

23. Streptomycin. (para 2-8c)

24. To put a wet saline dressing on each of the primary lesions. (para 2-8c)

25. Hospitalize the patient, provide bed rest, and give meticulous fluid, electrolyte therapy. (para 2-3d)

26. Boots, gloves. (para 2-3e(1)

27. It is a widespread infectious, febrile disease affecting principally ruminants, cattle, swine, and goats; but sometimes it affects other animals (dogs, raccoons, opossums) including man. (para 2-4a)

28. Unpasteurized milk, other milk products. (para 2-4a)

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Helminthic Diseases.
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-12.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	3-1. Identify the definition, characteristics, signs/symptoms, and treatment for roundworms (nematodes).
	3-2. Identify the definition, characteristics, signs/symptoms, and treatment for tapeworms (cestodes).
	3-3. Identify the definition, characteristics, signs/symptoms, and treatment for flukes (trematodes).
SUGGESTION	After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

HELMINTHIC DISEASES

Section I. ROUNDWORMS (NEMATODES) DISEASES

3-1. GENERAL

a. The word helminth means worm. Helminthic diseases are diseases caused by parasitic worms. The most common human intestinal helminths are included in two large groups: nematodes or roundworms and platyhelminthes or flatworms. Two classes of platyhelminthes are important to human beings: trematodes (flukes) and cestodes (also called tapeworms). Disease-producing roundworms include hookworms and pinworms which live in the intestines; trichinal worms which infect the muscles; and filarial worms which invade the fluids beneath the skin. Disease-producing flatworms include tapeworms which live in the intestines and flukes which can invade the blood, intestines, liver, or lungs.

b. During your tour of duty in the Army, you are going to travel worldwide. You may encounter helminthic diseases common in the United States and some rarely seen in the US. In this lesson, you will learn to identify helminthic diseases of military importance. Your ability to recognize these diseases is of great importance to you and the troops you support.

3-2. CHARACTERISTICS

Roundworms (nematodes) are a group of slender, round worms, the main species of which are parasitic. This group includes about 500,000 species, 50 of which are parasites of man. The worms are nonsegmented with flattened, cylindric bodies which taper toward both ends. The mouth is frequently surrounded by thick lips or papillae. The sexes are distinctive with the male being shorter and more slender than the female. They range from so small as to be seen only with a microscope to over 3 feet. They live in water and air as well as plants and animals. The two basic groups of nematodes are intestinal nematodes and tissue nematodes.

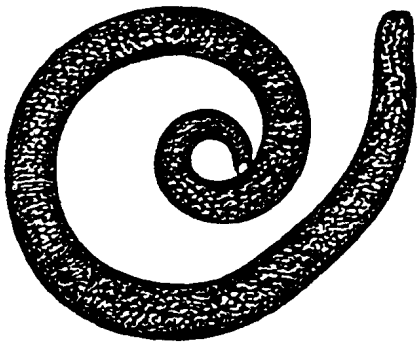

Figure 3-1. Nematode.

a. **Intestinal Nematodes.** This group of nematodes is wide spread in the tropics and subtropics. In the Western Hemisphere, tropical Africa, the Far East, and the Mediterranean, infection from these nematodes is prevalent where there are overcrowding and poor sanitary conditions. Hookworm and pinworm are examples of intestinal nematodes commonly found in the United States. For both, the normal vector for transmission is contact with fecal material of infected organisms. Threadworms and whipworms are two more types of intestinal nematodes that attack man. Threadworm disease is endemic (a constant presence) in the tropics, generally in the same unsanitary conditions favorable to the spread of hookworm. Whipworm disease, found worldwide and especially in warm, moist regions, flourishes in areas of inadequate sanitation and poor personal hygiene habits.

Figure 3-2. Intestinal nematode.

b. **Tissue Nematodes.** Tissue nematodes are found in all areas of the world. Trichinella spiralis, which causes trichinosis, is a tissue nematode found in temperate climates. Humans become infected by eating inadequately cooked pork and pork products that are contaminated. Figure 3-2 shows this parasite encapsulated in a muscle. Contact with the feces of infected dogs or cats is the source of infection for toxacariasis. Other tissue nematodes are transmitted by bites of infected mosquitoes and flies, usually in the tropics.

Figure 3-3. Tissue nematode.

c. **Transmission.** The method of transmission for human roundworm infection is from humans to soil to humans. Sterile eggs are discharged in the feces of an infected person. The eggs undergo development (embryonation) for about 3 weeks in soil at summer temperatures. People are infected with this parasite by eating soil-contaminated salads or other soil-contaminated foods. Soil can be carried long distances on feet or footwear into houses and vehicles. Children frequently have heavy roundworm infection from eating contaminated dirt. (Refer to figure 3-4.) Infection by the roundworm Ascaris lumbricoides in the small intestine causes colicky pains and diarrhea, especially in children.

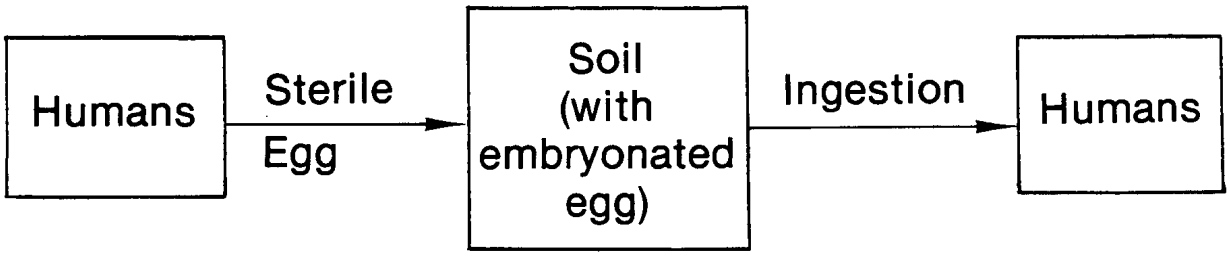

Figure 3-4. Roundworm cycle of transmission.

3-3. SIGNS AND SYMPTOMS

a. Signs and symptoms of intestinal nematodes are as follows:

(1) Pneumonitis (an inflammation of the lungs).

(2) Fever.

(3) Cough.

(4) Hemoptysis (expectoration of blood or blood-stained sputum).

(5) Urticaria (vascular reaction of the skin marked by the transient appearance of smooth, slightly elevated patches [wheals] which are redder or paler than the surrounding skin and which itch severely).

(6) Epigastric/abdominal pain (pain in the upper middle region of the abdomen or pain in the abdominal area).

(7) Vomiting.

(8) Diarrhea (abnormal frequency and liquidity of fecal discharges).

b. Signs and symptoms of tissue nematodes are as follows:

(1) Ocular disturbances/pain (abnormal visual tolerance of light).

(2) Edema of eyelids (swelling of eyelids; presence of abnormally large amounts of fluid in the intercellular tissue space of the eyelids).

(3) Subconjunctival and retinal hemorrhage (bleeding from the subjunctival or retinal areas).

(4) Fever.

(5) Myalgia (pain in a muscle or muscles).

(6) Urticaria (same as for intestinal nematodes).

(7) Rash.

(8) Localized swelling.

3-4. TREATMENT

a. **Intestinal Nematodes.** Mebendazole is the drug of choice for whipworm infection. Do not use this drug in pregnancy. A light whipworm infection, one that requires stool concentration procedure to detect, does not require treatment. For hookworm infection, pyrantel pamoate is the drug of choice. For threadworm infection, the drug of choice is thiabendazole.

b. **Tissue Nematodes.** Thiabendazole is the drug of choice for trichinosis. Diethycarbomazine is also used to treat tissue nematodes. When indicated, symptomatic treatment of nematodes is given: prednisone for otic (ear) disorders, antihistamines for otic inflammation, corticosteroids for urticaria and rashes, analgesics for muscle pain.

Section II. TAPEWORM (CESTODE) DISEASES

3-5. CHARACTERISTICS

Tapeworms, cestodes, are elongated, ribbonlike worms which are intestinal parasites in all classes of vertebrates. Generally, tapeworms have three major parts: the head, the neck, and a chain of individual segments. The head is unusually small and is the part of the tapeworm which buries itself in the intestinal mucosa and anchors the worm. The neck has no segments. The last part of the worm is composed of individual segments, each of which gets nourishment from the host's intestinal juices by osmosis. Tapeworm size varies from 2.5 cm to 9 meters (30 feet).

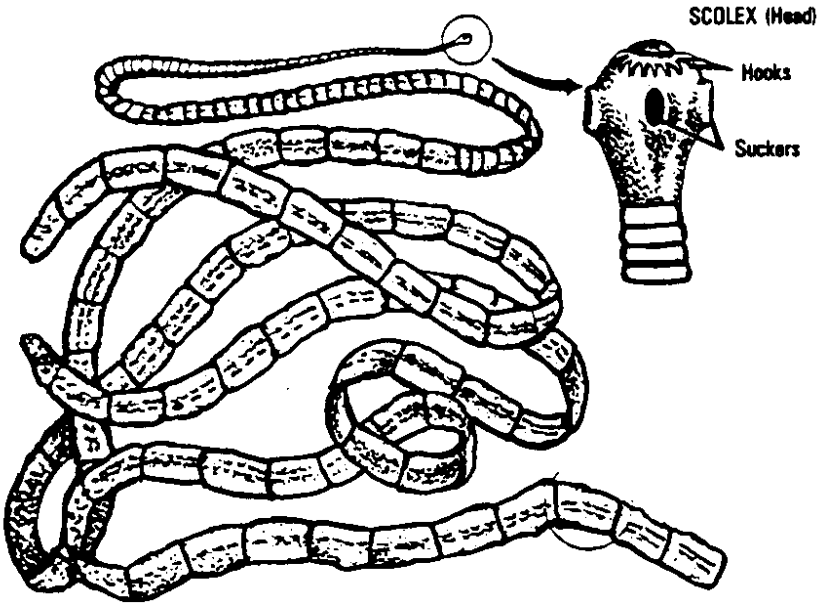

Figure 3-5. Tapeworm (pork tapeworm).

a. **Species of Medical Importance.** There are a number of species of tapeworm which are human parasites, but only these six attack man frequently:

(1) Beef tapeworm (Taenia saginata)--common and found worldwide.

(2) Pork tapeworm (Taenia solium)--common and found worldwide, but no longer transmitted in the US.

(3) Fish tapeworm (Diphyllobothium latum)--found in cold or temperate lake regions worldwide, particularly in Europe, US, and Japan; also in the Middle East, central and southern Africa, and in Chile.

(4) Dwarf tapeworm (Hymenolepis nana)--found worldwide.

(5) Dwarf tapeworm (Hymenolepis diminuta)--found worldwide.

(6) Dog tapeworm (Dipylidium canim)--found in children in Europe and the Americas.

b. **Beef Tapeworm.** (Taenia saginata). The beef tapeworm is the most common tapeworm in the United States. Tapeworm segments leave the host, and eggs are expelled from the segments. The eggs hatch when they are ingested by cattle. Embryos are released and lodge in the muscles of the cattle. When humans eat undercooked beef from infected cattle, cysticerci, a larval form of tapeworm, have also been eaten. In the human intestine, the cysticercus develops into an adult tapeworm.

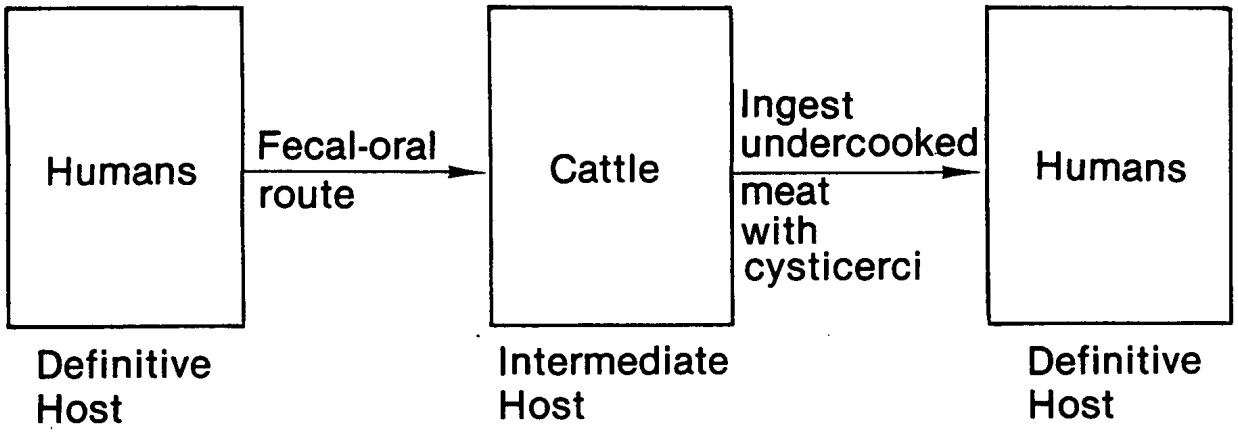

Figure 3-6. Beef tapeworm cycle of transmission.

c. **Pork Tapeworm (Taenia solium).** The cycle of development is similar to that of the beef tapeworm. In this case, the host for the larval stage is the pig. Humans are infected by eating undercooked pork containing tapeworm larvae. Humans may also be infected in two other ways: by another person through fecal contamination and by auto-infection (infection by one part of the body to another part of the body). Transmission in the last two ways could be prevented by practicing good personal hygiene.

d. **Fish Tapeworm (Diphyllobothrium latum).** Eggs are passed in human or animal feces into bodies of fresh water. There the eggs mature, hatch, and infect the first intermediate hosts, copepods. Some species of freshwater fish ingest infected copepods and become second intermediate hosts. In the second intermediate host, the worms develop into the larval stage. Humans become infected by eating raw or poorly cooked fish, the second intermediate host, which contain tapeworm larvae.

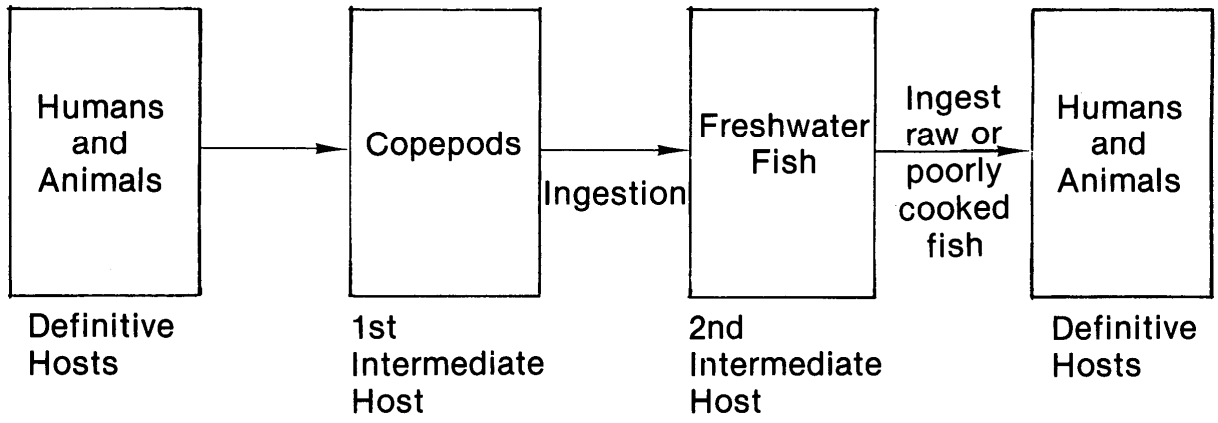

Figure 3-7. Fish tapeworm cycle of transmission.

e. **Dwarf Tapeworm (Hymenolepis nana).** The development of this tapeworm is unusual in that both the larval and adult stages are found in the human intestine. Infective eggs are expelled by adult worms in the human intestine. Larvae hatch and develop to maturity, still in the human intestine. No intermediate host is needed; therefore, transmission can be from person to person.

f. **Dwarf Tapeworm (Hymenolepis diminuta).** This tapeworm is a parasite common to rodents. Intermediate hosts are rat fleas, beetles, and cockroaches. Humans become infected by accidentally swallowing infected arthropods (rat fleas, beetles) which are in cereals or stored products. Children, especially, are likely to swallow these arthropods in precooked cereals.

NOTE: Generally, a person infected with dwarf tapeworms will have several. However, a person infected with the larger tapeworms will rarely have more than one or two worms.

3-6. SIGNS AND SYMPTOMS

Generally, adult tapeworms in the human intestine do not compete with the host for food substances; therefore, the worms cause no symptoms. However, a heavy tapeworm infection may cause diarrhea, abdominal pain, and anorexia. Approximately 1 to 2 percent of those having fish tapeworm may develop anemia. Persons infected by the pork tapeworm sometimes have central nervous system involvement. In the central nervous system, cysticerci (the larvae of the pork tapeworm) are usually located in the meninges, cerebral cortex, ventricles, and occasionally the parenchyma. The symptoms, occurring several years after the infection, are brought on by the death of the larvae triggering inflammatory toxic reactions. The signs and symptoms are clear and can resemble those for cerebral tumor, basal meningitis, encephalitis, intracranial hypertension, and hysteria. The most prominent symptoms are those of recurrent epileptiform attacks.

3-7. TREATMENT

For all types of tapeworm, the drug of choice is niclosamide. An alternative drug is paromomycin, less effective but available commercially. The best treatment is prevention. First, be sure there is adequate sanitation. Prevent human feces from contaminating soil, animal food, and water. Avoid irrigating pastures with sewage. Secondly, cook beef, pork, and fish thoroughly. Finally, practice good hygiene.

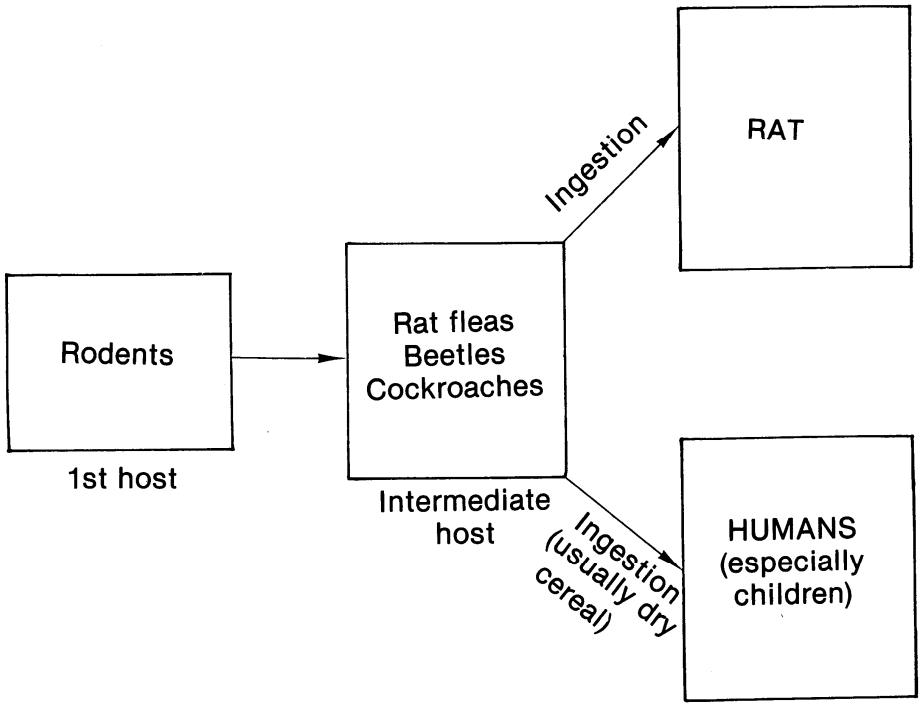

Figure 3-8. Dwarf tapeworm (Hymenolepis diminuta) cycle of transmission.

Section III. FLUKE (TREMATODES) DISEASES

3-8. CHARACTERISTICS

Flukes or trematodes are flatworms which are internal or external parasites in humans and animals. There are about 6,000 species of flukes in the world. They range in size from 5 mm (0.2 inches) to several centimeters. Most are not longer than 100 millimeters (4 inches). The most distinctive external feature of the fluke is the suckers or acetabula used by the worm to attach itself to another animal, the host. Most flukes have a sucker around the mouth and another along the back. A few have a third sucker near the posterior end.

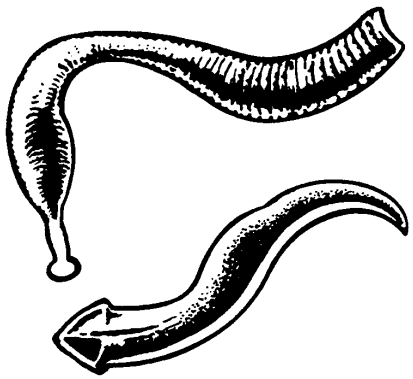

Figure 3-9. Flukes.

a. A fluke is an exclusive parasite. This means that it cannot sustain itself and must live on a host to receive nourishment and oxygen for survival. Flukes may be found in the intestine, liver, lungs, blood, and other body parts. People sometimes become infected with flukes by eating uncooked fish, crabs, or vegetables.

b. There are classes or subgroups of flukes: Monogenea, Aspidogastrea, and Digenea. The Monogenea are external parasites which attach themselves to fish, amphibians, and reptiles. The Aspidogastrea, either internal or external parasites, are usually found on mollusks. Digenea, internal parasites found in humans and other warm-blooded animals, is the only group of major importance to humans. Parasites of this group cause a variety of disease in humans throughout the world.

c. The life cycle of digenea flukes requires at least one intermediate host, sometimes two depending on the species. Sexually mature flukes lay hundreds of thousands of eggs which are passed into or near fresh water in feces from an infected person or animal. Either the eggs hatch immediately after they are expelled, or they are injected by an intermediate host. Mollusks--usually snails, mussels, or crabs--are the intermediate host in which a complex development cycle takes place, the development of the larvae. Some flukes are able to infect the final host from this stage. Other flukes, still in the larval stage, leave the first host and go to another host--a fish, crustacean, or another mollusk. Finally, the larvae escape from the second intermediate host, encyst on vegetation, or penetrate directly into the skin of the final host.

d. Digenea are further classified according to the area of the host's body in which fluke development into adults is completed and their eggs are deposited. From this standpoint, there are flukes that live in the intestine, liver, lungs, and the portal venus system. These are important to humans:

(1) Blood fluke--developing and laying eggs in the portal venous system and its tributaries.

(2) Liver fluke--makes its home in the liver.

(3) Intestinal fluke--its habitat is the intestine.

(4) Lung fluke--residing in the lungs.

3-9. BLOOD FLUKES

A variety of diseases throughout the world are caused by three species of blood flukes: intestinal blood flukes, urinary blood flukes, and Oriental blood flukes.

a. **Intestinal Blood Flukes.** The intestinal blood fluke, Schistosoma mansoni, commonly attacks humans in China, Taiwan, Southeast Asia, India, Africa, and northern South America. Fluke eggs are shed in stools that reach the water. The eggs hatch to produce free-swimming larvae that penetrate and develop in the flesh of snails, the intermediary host. Cercariae, the final free-swimming larval stage of the fluke, escape from the snails and encyst on various water plants. Humans become infected when they eat uncooked plants, usually water chestnuts, or other caltrops. The adult flukes live in a human's small intestine attached to the mucosa or buried in mucous secretions. These adult flukes mature in about three months.

b. **Urinary Blood Flukes.** The urinary blood fluke, Schistosoma hematobium, is a parasite which occurs in Egypt, Africa, and in parts of the Middle East. The general process of development in the first stages is the same for all blood flukes. The adult urinary blood fluke enters the body of the final host, a human, and matures in the venous plexuses of the bladder, prostate, and uterus. Eggs are passed in the urine or retained in the tissues, particularly the bladder wall and the female genital organs. Among the problems caused by this parasite are fibrosis, ulceration, and granuloma and papilloma formation, bladder wall calcification, chronic cystitis, pyelitis, and pyelonephritis. In Egypt, bladder cancer is common in advanced cases.

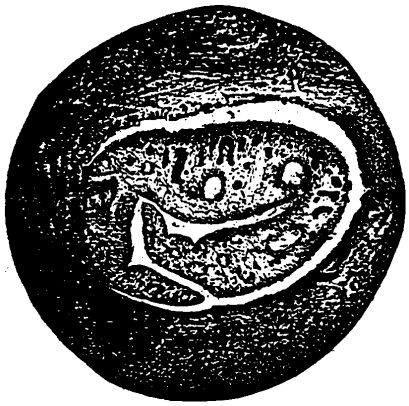

Figure 3-10. Adult fluke in a bile duct.

c. **Oriental Blood Flukes.** Infection by the Oriental blood fluke, Schistosoma japonicum, is prevalent in China, Japan, Philippines, and Sulawesi. In some areas, more than half the population is infected. The initial stages of development are the same as for the intestinal and urinary blood fluke. This adult parasite, however, develops in the veins of the small intestine. Some eggs are carried upstream to various organs, causing a variety of symptoms including enlargement of the liver.

d. **Signs and Symptoms of Blood Flukes.** Blood flukes live in the final host over a span of several years. Eggs produce minute granulomata and scars in organs where they lodge or are deposited. The symptoms experienced by humans depend on the location of the parasite in the human host.

(1) Clinical stages. Generally, three clinical stages of infection can be delineated. In the first phase, there is an itchy erythematous or petechial rash at the sites of penetrates of the cercariae, the free-swimming larvae; this lasts from two to five days. In the second clinical phase, four to five weeks later, the symptoms are primarily allergic and of varied severity. There may be fever, urticaria, malaise, respiratory symptoms, and the liver and the spleen may be temporarily enlarged. In two to eight weeks, the person becomes asymptomatic. The final clinical phase, which can occur six months to several years after infection, is characterized by diarrhea, dysentery, intestinal tumors, portal hypertension, and hepatic insufficiency. It should be noted that these parasites can live for many years. Some people with light infections are asymptomatic and never have signs or symptoms of parasitic disease.

(2) Course and severity. Remember that the course and severity of the disease caused by the blood fluke depends on three elements:

(a) The number of adult worms present.

(b) The number of eggs produced.

(c) The sites of the lesions the worms cause.

(3) Intestinal blood flukes. Early symptoms are diarrhea, dysentery, and abdominal pain. Symptoms of later stages include anorexia, weight loss, polypoid intestinal tumors. Signs of portal hypertension and hepatic insufficiency are also in evidence.

(4) Urinary blood flukes. In the urinary form of the disease, the patient may have the signs/symptoms of ureteral and renal damage ending in fatal uremia. The infected human might die of bladder carcinoma many years after being infected.

(5) Oriental blood flukes. Symptoms are similar to those of intestinal blood flukes, but the disease is more serious. Complications that come from chronic infection can be fatal.

e. **Treatment.** The drug of choice for all three species of blood fluke--intestinal blood fluke, urinary blood fluke, and Oriental blood fluke--is praziquantel. Alternative drugs are as follows:

(1) Intestinal blood fluke disease--oxamniquine.

(2) Urinary blood fluke disease--metrifonate or niridizole.

(3) Oriental blood fluke disease--niridizole or stibocaptate.

3-10. LIVER FLUKES

A liver fluke is a parasite flatworm that invades the liver and bile ducts of humans and other animals. This worm requires an intermediate host for its development, making it digenetic. Two important liver flukes infect humans: the sheep liver fluke (Fasciola hepatica) and the Chinese liver fluke (Clonorchis sinensis).

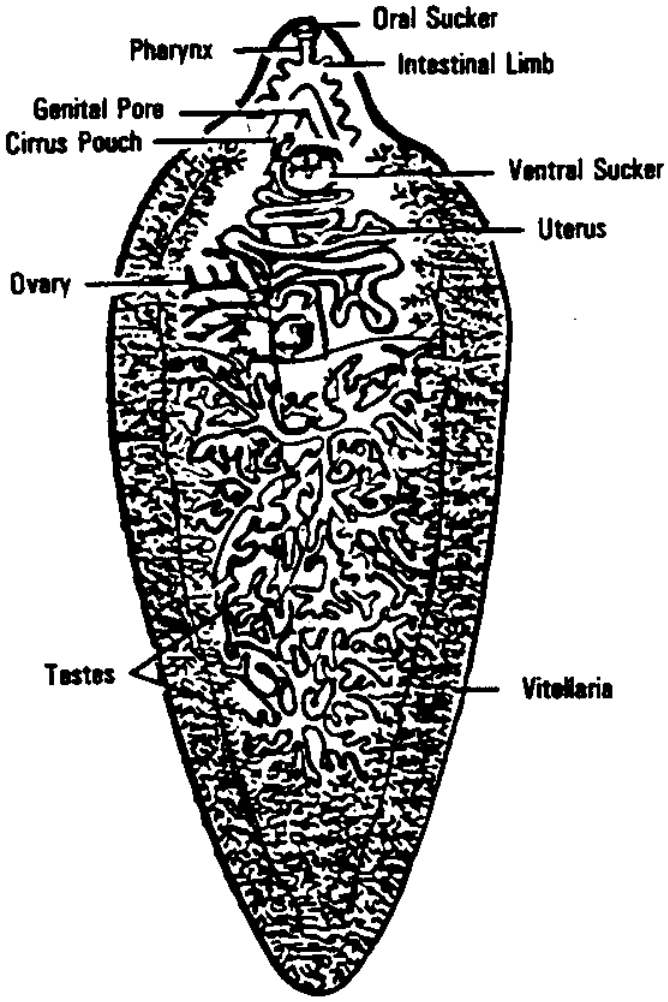

Figure 3-11. Liver fluke.

a. **Sheep Liver Fluke.** This parasite, Fasciola hepatica, is common in the sheep-raising areas of the world.

(1) The adult is a fleshy, leaf-shaped, hermaphroditic flatworm. It is about 30 millimeters long by 13 millimeters wide. The worm lays immature eggs which are passed in the feces of the host, an infected animal. The eggs must reach the water to mature and hatch. When the eggs hatch, they release a miracidium (a ciliated larval form). The miracidium invades some varieties of snails, the snails being the intermediate host. In the snail, the miracidium matures into a cercaria (a tailed larva). The cercaria leaves the snail, is free-swimming for a short time, and then encysts in the water or on aquatic vegetation. If it is kept moist, the cyst remains alive for a long time.

(2) Man becomes infected by drinking cyst-infected water or eating cyst-infected vegetation. The ingested cyst dissolves in the intestines, releasing the larva. The larva migrates through the intestinal wall and into the liver and bile ducts, where it matures.

(3) The incidence of liver fluke disease in man is on the increase in cattle and sheep raising areas. Epidemics of watercress-borne liver fluke disease have occurred in Europe and South America.

b. **Chinese Liver Fluke.** Also called Clonorchis sinensis, this parasite occurs primarily in Japan, Korea, and most of China.

(1) The adult worm is flabby, transparent, and spatual-shaped. It is 10 to 25 millimeters long and 3 to 5 millimeters wide. Like the sheep fluke, it lays immature eggs which must reach water to mature and hatch. When the eggs hatch, the ciliated larva is released. This larva invades a snail, not the same genre of snails as the sheep liver fluke, and matures into a tailed larva. The tailed larva (the cercaria) leaves the snail and finally encysts on or in various species of freshwater fish.

(2) Humans or other animals contract Chinese liver fluke disease by eating raw, cyst-infected fish.

c. **Signs and Symptoms.** From the time they are infected, most people are permanently free of symptoms and have few worms. People with a heavy infection will experience these signs/symptoms.

(1) Sheep liver fluke. In the early stages of the disease, there is fever, pain over the liver, diarrhea, loss of weight, and an increase in the number of certain white blood cells, eosinophils. These symptoms are caused by the damage done to the liver by the young flukes which are actually feeding on the liver tissue.

(2) Chinese liver fluke. Loss of appetite, diarrhea, fever, and a sensation of abdominal pressure are early symptoms. Later, there may be bile duct obstruction, sometimes producing jaundice, followed by cirrhosis, enlargement and tenderness of the liver and progressive ascites and edema.

d. **Treatment.** There is no satisfactory specific drug, and treatment is mainly for the symptoms. If a drug is given, these are the choices.

(1) Sheep liver fluke. The drug of choice is bithionol because of its low toxicity. Emetine hydrochloride can be used if bithionol is not available. A drug less toxic than emetine is dehydroemetine.

(2) Chinese liver fluke. Two drugs are beneficial although they do not cure the disease: chloroquine phosphate and hetol. The newest drug of choice is praziquantel.

3-11. INTESTINAL FLUKES

The intestinal fluke Fasciolopsiasis is a parasite found in the large intestine. It is commonly found in humans and pigs in China, Taiwan, Southeast Asia, and India.

a. **Life Cycle.**

(1) The life cycle begins when eggs shed in stools reach the water. They hatch in the water and become free-swimming larvae that penetrate and then develop in the flesh of snails. Cercariae (the final larval stage of the parasite (free-swimming with body and tail) leave the snails and encyst on various water plants.

(2) When humans eat these plants uncooked (usually water chestnuts or other caltrops), humans become infected with the disease. Adult flukes live in the small intestine where they attach themselves to the mucosa or bury themselves in mucous secretions. Flukes mature in about three months.

b. **Signs and Symptoms.** Gastrointestinal irritation is present in all infections except light infections. The following symptoms occur in severe infections:

(1) Early signs and symptoms. There may be cramping epigastric and hypogastric pains, diarrhea, intermittent constipation, anorexia, intestinal stasis, and nausea.

(2) Later signs and symptoms. Edema (abnormally large amounts of fluid in the intercellular tissue spaces) in the face and ascites (effusion and accumulation of serious fluid in the abdominal cavity) are later symptoms. Cachexia (general ill health and malnutrition) or intercurrent infection may eventually cause death.

c. **Treatment.** An effective drug is hexylresorcinal; however, recently the US has discontinued marketing hexylresorcinal. If hexylresorcinal is not available or not effective, use tetrachloroethylene. Another drug used in treatment is niclosamide, but it may not be as effective as the other two drugs. It is however, more convenient to give.

3-12. LUNG FLUKES

Paragonimus westermani, the lung fluke, is a parasite which uses humans and other animals as a host. The common name lung fluke comes from the fact that when infected, a human's lungs are frequently involved. This parasite occurs throughout the Far East, West Africa, South Asia, Central America, and northern South America.

a. **Life Cycle.**

(1) Fluke eggs reach the water, either in sputum or feces, and hatch in 3 to 6 weeks. Miracidia penetrate snails and develop. Next, cercariae leave the snails and encyst in the tissues of crabs and crayfish.

(2) Infection occurs when raw or partially cooked fresh water crabs and crayfish containing infected larvae are eaten. Pickling of crabs and crayfish in wine, brine, or vinegar--common practice in Asia--frequently does not kill the infected larvae. Most larvae migrate through the diaphragm and enter the lung parenchyma. Some larvae lodge in the peritoneum, the intestinal wall, liver, or other tissues; these usually do not mature. In rare instances, the larvae migrate to the brain or spinal cord. As the parasite matures, a capsule of fibrous and inflammatory tissue forms around it and later swells and ruptures into a bronchiole. Fluid containing eggs, blood, and inflammatory cells is released in expectorated in the sputum, and the cycle begins again.

b. **Signs and Symptoms.** Until the flukes mature and begin producing eggs, the infection shows no signs or symptoms. Gradually, there is a low-grade fever, cough, or hemoptysis. At first, the cough is dry; later, there is rusty or blood-flecked viscous sputum. Pleuritic chest pain is common. The condition is chronic and progresses slowly. People with light infections often do not seem seriously ill. In heavy infections, there is dyspnea, signs of bronchitis and bronchiectasis, weakness, malaise, and weight loss. Parasites in the peritoneal cavity or intestinal wall may cause abdominal pain, diarrhea, and dysentery. Those in the central nervous system, depending on their location, may cause seizures, palsies, or meningoencephalitis.

c. **Treatment.** Biothinol can be used for pulmonary infections; it is the drug of choice. Use antibiotics to control secondary pulmonary infection. An alternative method of treatment is a new drug, menichlopholan.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS. Answer the following exercises by writing the word or words in the space that properly completes the sentence or best answers the question.

After you have completed all of these items, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced after the answer.

1. What are helminthic diseases? _____

   _____

2. Hookworms and pinworms are disease producing roundworms which live in the _____ of human beings.

3. _____ are disease producing flatworms which live in the intestines, and _____ are disease producing flatworms which can be found in the blood, intestines, liver, or lungs.

4. The main species of nematodes or roundworms are _____.

5. List two characteristics of a nematode body.

   a. _____.

   b. _____.

6. Name the two basic groups of nematodes.

   a. _____.

   b. _____.

7. Two intestinal nematodes commonly found in the United States are _____ and _____.

8. The normal vector for transmission of nematodes is _____ _____.

9. Trichinosis, a disease caused by a tissue nematode, is transmitted by _____ _____.

10. How is the disease toxocariasis transmitted? _____ _____

11. In the tropics, tissue nematodes are transmitted by _____ _____.

12. Pneumonitis, epigastric/abdominal pain, hemoptysis, and urticaria are signs/ symptoms of (intestinal nematodes/tissue nematodes). (choose one) _____

13. Use _____ to treat whipworm infection, but not if the patient is pregnant; use _____ to treat hookworminfection; and use _____ to treat threadworm infection.

14. List two drugs which could be used to treat tissue nematodes:
    a. _____.
    b. _____.

15. Symptomatic treatment of tissue nematodes includes using the drug _____ for otic disorders; _____ for otic inflammation; _____ for urticaria and rashes; and _____ for muscle pain.

16. Six species of tapeworm attack humans. Two of these species are the dwarf tapeworms, Hymenolepis nana and Hymenolepis diminuta. List the other four species using the common names.

    a. _____.

    b. _____.

    c. _____.

    d. _____.

17. Name the three parts of the adult tapeworm.

    a. _____.

    b. _____.

    c. _____.

18. Three methods of transmission of tapeworms are _____, _____, and _____.

19. A person infected by the tapeworm parasite will usually have (many / few) symptoms. (choose one.) _____

20. An individual with a heavy tapeworm infection may have symptoms such as _____, _____, and _____.

21. A small percentage, 1 to 2 percent, of people having _____ tapeworm, may develop anemia.

22. In some instances of _____ tapeworm, central nervous system disorders have been reported.

23. For all types of tapeworm infection, the drug of choice is _____, with _____ being a less effective but commercially available drug.

24. List two major methods of prevention of tapeworm disease.

    a. _____.

    b. _____.

25. The most distinctive external feature of a fluke is the _____ which the fluke uses to attach itself to its host.

26. List the four types of Digenea flukes.

    a. _____.

    b. _____.

    c. _____.

    d. _____.

27. In humans, flukes may be found in these four parts of the body:

    a. _____.

    b. _____.

    c. _____.

    d. _____.

28. Humans become infected with _____ blood flukes when they eat water chestnuts encysted with the larva.

29. The blood fluke which matures in the venous plexuses of the bladder, prostate, and uterus is the _____.

30. The blood fluke which develops in the veins of the small intestine is the _____.

31. The severity of the disease caused by blood flukes depends on these three elements:

    a. _____.

    b. _____.

    c. _____.

32. The two types of liver flukes are _____ and _____.

33. List four signs/symptoms of the early stages of a severe infection of intestinal fluke.

    a. _____.

    b. _____.

    c. _____.

    d. _____.

34. A person with a heavy infection caused by _____ may experience weakness, malaise, weight loss, and show signs of bronchitis and bronchiectasis.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. Helminthic diseases are diseases caused by parasitic worms. (para 3-1a)

2. Intestines. (para 3-1a)

3. Tapeworms, flukes. (para 3-1a)

4. Parasitic. (para 3-2)

5. Slender, round. (para 3-2)

6. Intestinal nematodes, tissue nematodes. (para 3-2)

7. Hookworm, pinworm. (para 3-2a)

8. Contact with fecal material of infected organisms. (para 3-2a)

9. Eating inadequately cooked pork and pork products that are contaminated. (para 3-2b)

10. Through contact with the feces of infected dogs or cats. (para 3-2b)

11. By bites from infected mosquitoes or flies. (para 3-2b)

12. Intestinal nematodes. (para 3-3a)

13. Mebendazole, pyrantel pamoate, thiabendazole. (para 3-4a)

14. Thiabendazole, diethylcarbomazine. (para 3-4b)

15. Prednisone, antihistamine, corticosteroid, analgesic. (para 3-4b)

16. Beef tapeworm.
    Pork tapeworm.
    Fish tapeworm.
    Dog tapeworm. (para 3-5a)

17. Head.
    Neck.
    Individual segments or chain of individual segments. (para 3-5)

18. Any three of the following are correct:

    Eating undercooked beef from infected cattle. (para 3-5b)
    Eating undercooked or raw, infected fish. (para 3-5d)
    Contact with contaminated fecal matter. (para 3-5c)
    Autoinfection. (para 3-5c)

19. Few. (para 3-6)

20. Diarrhea, abdominal pain, and anorexia. (para 3-6)

21. Fish. (para 3-6)

22. Pork. (para 3-6)

23. Niclosamide, paromomycin. (para 3-7)

24. Any two of the following are correct:

    Be sure of adequate sanitation.
    Thoroughly cook beef, pork, and fish.
    Practice good hygiene. (para 3-7)

25. The suckers or acetabula. (para 3-8)

26. Blood flukes.
    Liver flukes.
    Lungs.
    Lung flukes. (para 3-8d)

27. Intestine.
    Liver.
    Lungs.
    Portal venus system. (para 3-8d)

28. Intestinal. (para 3-9a)

29. Urinary blood fluke. (para 3-9b)

30. Oriental blood fluke. (pare 3-9c)

31. The number of adult worms present.
    The number of eggs produced.
    The sites of the lesions the worms cause. (para 3-9d(2))

32. Sheep liver fluke, Chinese liver fluke. (para 3-10)

33. Any four of the following are correct:
Cramping epigastric and hypogastric pains.
Diarrhea.
Intermittent constipation.
Anorexia.
Intestinal stasis.
Nausea. (para 3-11b)

34. Lung flukes. (para 3-12b)

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Malaria.
LESSON ASSIGNMENT	Paragraphs 4-1 through 4-7.
LESSON OBJECTIVES	After completing this lesson, you should be able to: 4-1. Identify the definition, characteristics, signs/symptoms, and treatment for malaria.
SUGGESTION	After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 4

MALARIA

4-1. GENERAL

Malaria is an infectious febrile disease caused by protozoan parasites of the genus Plasmodium. This disease continues to be widespread outside the United States in tropical, subtropical, and temperate climates, places where the Anopheles mosquito breeds. The malarial belt includes parts of Mexico, Haiti, the Dominican Republic, Honduras, Ecuador, Africa, India, Southeast Asia, and the Philippines.

4-2. TRANSMISSIONS

Malaria is transmitted in three ways: from infected people to healthy people via mosquito bites (mosquitoes carry the parasite); from hypodermic injections using a syringe or an infected person and then on a healthy person); and from blood transfusions (giving blood from an infected person to a healthy person). By far the most common vector for the malarial parasite is the mosquito. Although there are many species of mosquitoes, only a few carry human disease parasites. There are four species of human malarial parasites, all carried by the mosquitoes of the genus Anopheles. Only the female bites humans. She does so to get the blood she needs for egg-laying.

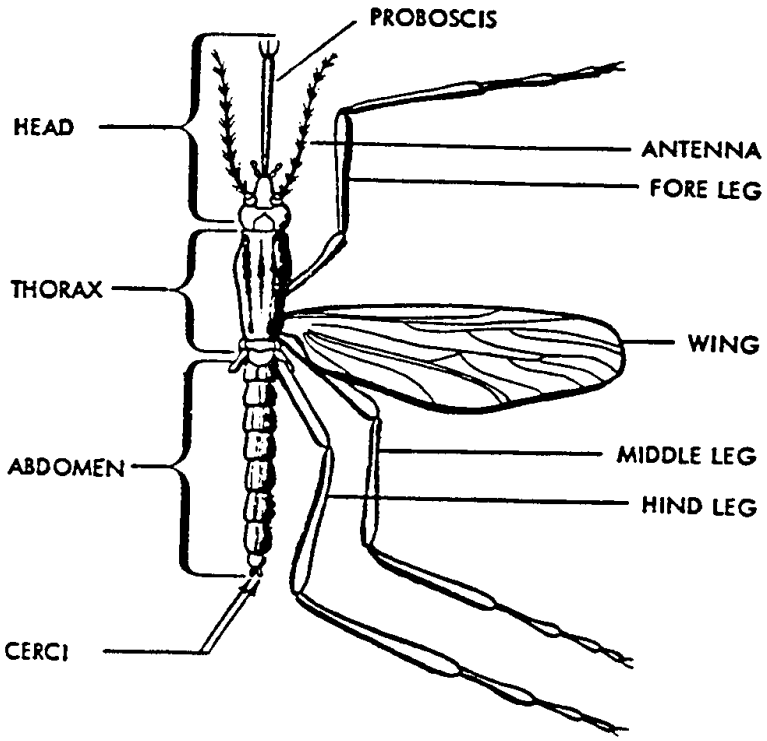

Figure 4-1. Adult Anopheles mosquito.

4-3. CYCLE OF INFECTION

The cycle of infection of the malarial parasite is as follows. An uninfected mosquito bites an infected human and becomes infected. Malarial parasites enter the mosquito's body, and sexual reproduction takes place. The resultant cells move to the mosquito's salivary glands. If this mosquito bites a human within two weeks, the human will become infected. The mosquito bites, and sporozoites enter the human's bloodstream and circulate for one half hour. The sporozoites then enter the human's liver cells and reproduce asexually. Later, the parasites leave the liver cells and enter the bloodstream. (The length of time before leaving depends on the species of malarial parasite.) The parasites, now called merozoites, enter the circulating red blood cells and multiply. Some 48 to 72 hours later, the red blood cells break open and release other merozoites. These merozoites will infect other red blood cells. If an uninfected mosquito bites this person, the cycle of transmission will begin again.

4-4. MALARIA WITHIN THE UNITED STATES.

As shown in the cycle of transmission, the malarial parasite needs two hosts to survive and reproduce, man and the mosquito. In the parasite's two stages of development, the asexual stage takes place in the human body, and the sexual stage takes place in the mosquito. If the parasite cannot pass back and forth from the mosquito to the human host and from the human host to the mosquito, the chain of transmission is broken, and the disease ends. The disease has been almost eradicated in the US. A glance at figure 4-2 shows world events which have caused malaria to reenter the US.

4-5. STAGES

Characteristically, there are three stages of malaria attacks.

a. **Stage 1**. A shaking chill. Parasites are rupturing the person's red blood cells and escaping into the bloodstream.

b. **Stage 2**. Spiking fever,nausea, vomiting, and headache. The patient's temperature rises to about 104ºF (40ºC), and the patient has a severe headache. This takes place when the parasites are ready to invade red blood cells.

c. **Stage 3**. After several hours, the patient begins sweating profusely. The headache disappears, and the temperature returns to normal. The patient falls asleep frequently.

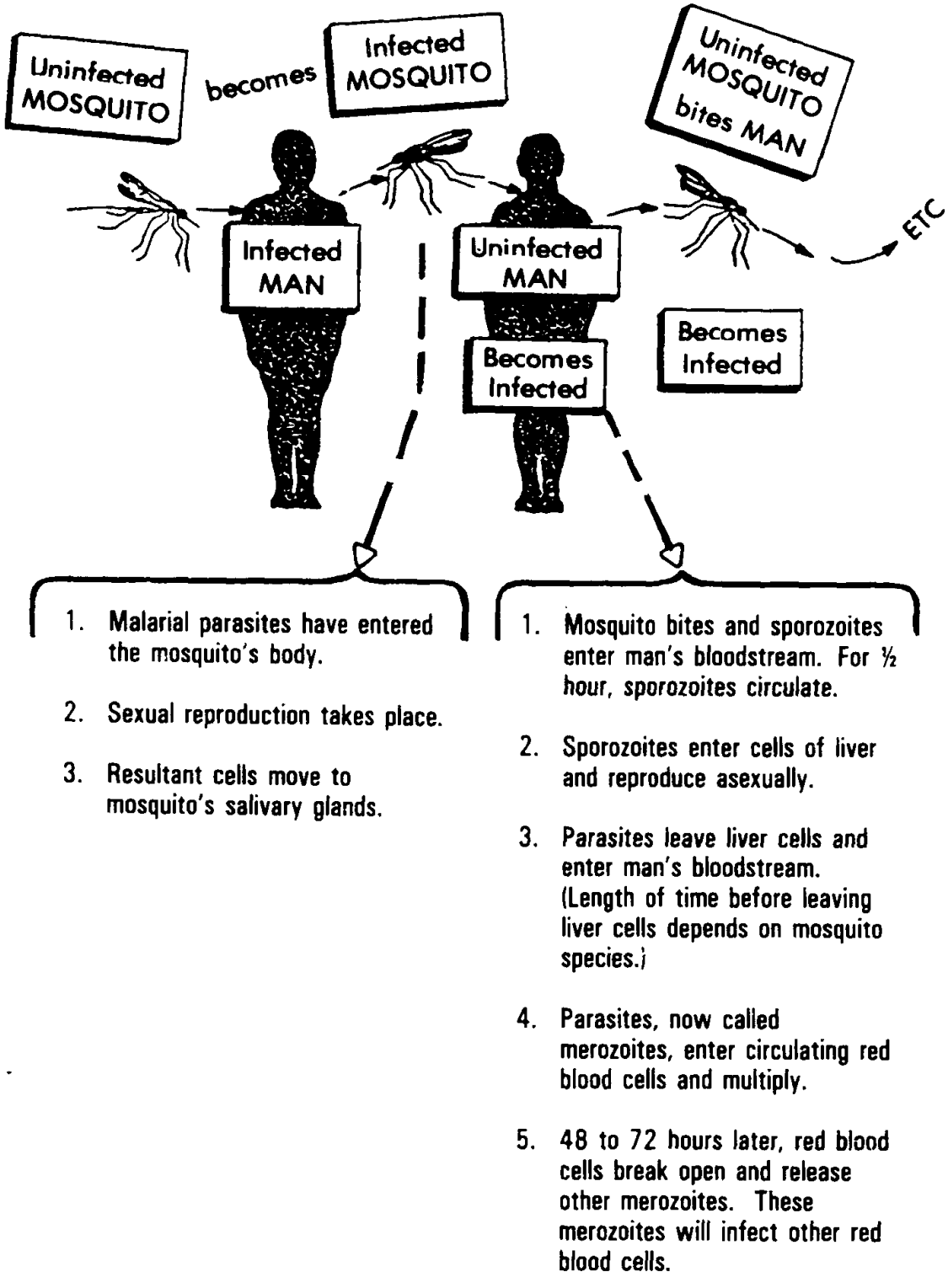
Uninfected MOSQUITO
becomes
Infected MOSQUITO
Uninfected MOSQUITO bites MAN
ETC
Infected MAN
Uninfected MAN
Becomes Infected
Becomes Infected
1. Malarial parasites have entered the mosquito's body.
2. Sexual reproduction takes place.
3. Resultant cells move to mosquito's salivary glands.
1. Mosquito bites and sporozoites enter man's bloodstream. For ½ hour, sporozoites circulate.
2. Sporozoites enter cells of liver and reproduce asexually.
3. Parasites leave liver cells and enter man's bloodstream. (Length of time before leaving liver cells depends on mosquito species.)
4. Parasites, now called merozoites, enter circulating red blood cells and multiply.
5. 48 to 72 hours later, red blood cells break open and release other merozoites. These merozoites will infect other red blood cells.

Figure 4-2. Malarial cycle of transmission.

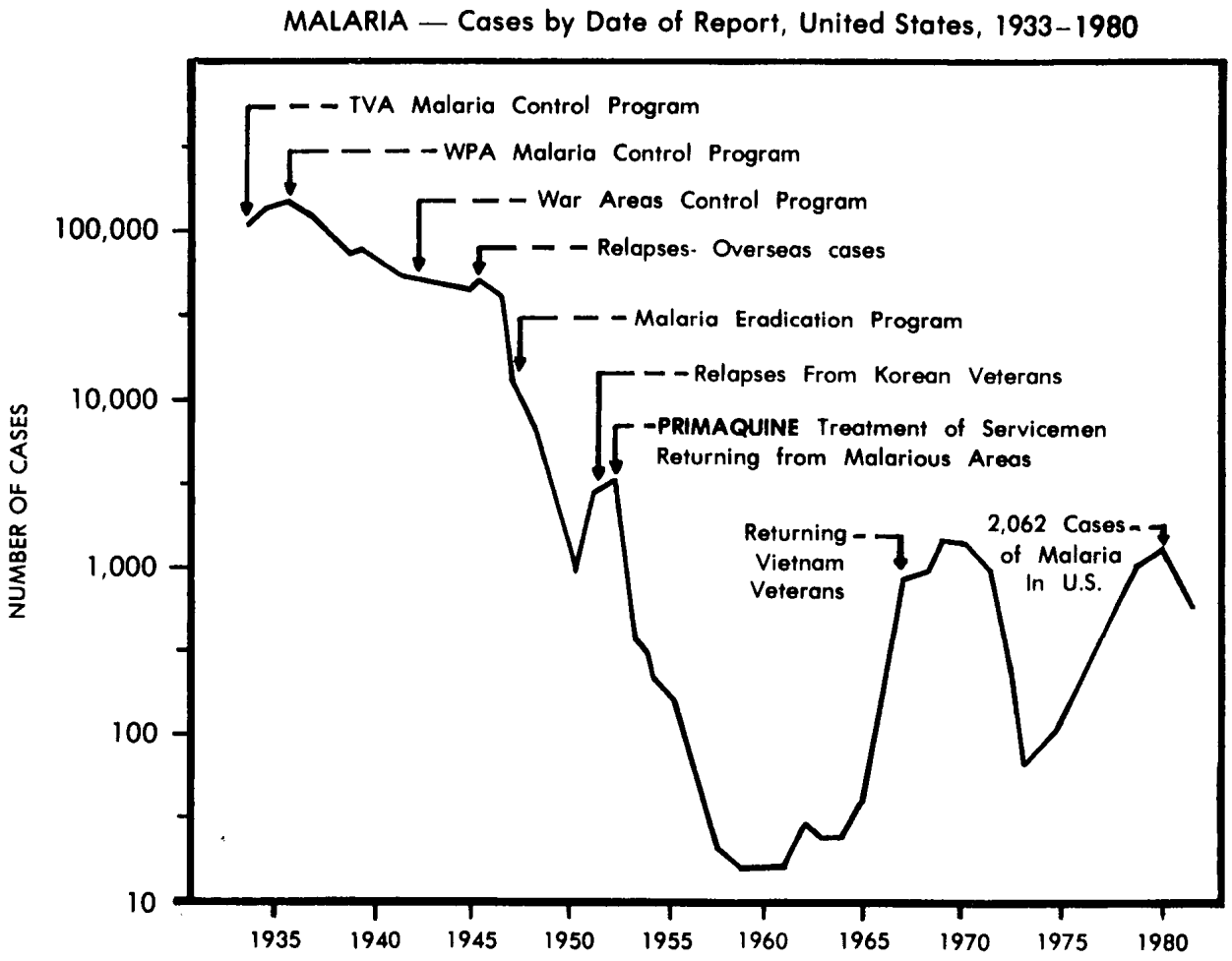

Figure 4-3. World events and malaria cases in the United States.

4-6. COMPLICATIONS

It is possible to have serious complications of malaria. People who have had repeated malaria attacks with inadequate treatment may experience the following: headache, convulsions, delirium, and coma. Other symptoms include hyperpyrexia, closely resembling heat hyperpyrexia, and gastrointestinal disorders similar to cholera or acute bacillary dysentery. People who have had falciparum infections and a history of irregular quinine dosage may have anemia, jaundice, fever, and hemoglobinuria. Relapses are common and may occur at irregular intervals for several years.

4-7. TREATMENT

There are sixteen different types of malaria, and treatment depends on the type of malaria and the stage and involvement of the disease. The main goal of treatment is to destroy the parasites while they are in the person's (the host's) blood cells. The drug of choice is chloroquine which interferes with the parasite's development while it is in the red blood cells. Individuals who have Plasmodium ovale or Plasmodium vivax parasites may have prolonged liver infections and should also take the drug primaquine. If the organisms are resistant to chloroquine, a combination of three drugs (quinine, pyrimethamine, and a sulfa drug) may be used. Mepacrine is another drug which can be used.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS. Answer the following exercises by writing the word or words in the space that properly completes the sentence or best answers the question or by selecting the response that best completes the senctence.

After you have completed all of these items, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced after the answer.

1. List three types of climates in which the malarial-carrying mosquito breeds.

   a. _____

   b. _____.

   c. _____.

2. Three countries included in the malarial belt are:

   a. _____.

   b. _____.

   c. _____.

3. What kind of parasites causes malaria? _____

4. Is malaria a disease which a person could have just once or more than once?

   _____

5. A shaking chill is characteristic of the _____ stage of malaria.

6. In one stage of malaria, the patient's temperature climbs to about 104 degrees Fahrenheit, and the person experiences spiking fever, _____, vomiting, and _____.

7. Later, the patient begins sweating profusely; the temperature returns to normal; and the patient _____.

8. There are _____ types of malaria.

   a. Two.

   b. Three.

   c. Twelve.

   d. Sixteen.

9. The drug of choice interferes with the malaria parasite's development in the red blood cells and is _____.

10. Other drugs which could be used are _____, _____, and _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 4

1. Tropical.
   Subtropical.
   Temperate. (para 4-1)

2. You are correct if you listed any three of the following:

Mexico.	Africa.
Haiti.	India.
The Dominican Republic.	Southeast Asia.
Honduras.	The Philippines.
Ecuador.	

   (para 4-1)

3. Mosquitos of the genus Anopheles. (para 4-2)

4. A person can have malaria repeatedly. (para 4-6)

5. First. (para 4-5a)

6. Nausea, headache. (para 4-5b)

7. Falls asleep frequently. (para 4-5c)

8. d. (para 4-7)

9. Chloroquine. (para 4-7)

10. Quinine, pyrimethamine, a sulfa drug. (para 4-7)

End of Lesson 4